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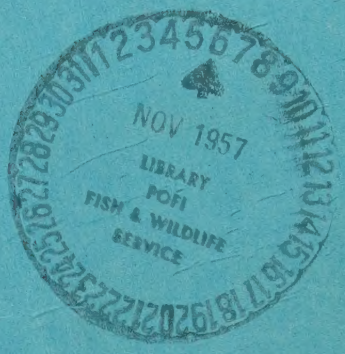
INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

Established by Convention between Canada, Japan and the United States for the Conservation of the Fisheries Resources of the North Pacific Ocean



ANNUAL REPORT

FOR THE YEAR

1956

VANCOUVER, CANADA

1957

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

MEMBERS - - 1956

CANADA

George R. Clark
John M. Buchanan
James C. Cameron
Roger T. Hager

UNITED STATES

Milton E. Brooding
Edward W. Allen
John H. Clawson
John L. Farley

JAPAN

Iwao Fujita
Koh Chiba
Masao Okai (to October 16, 1956)
Sakari Masuda (from October 16, 1956)
Kenkichi Nakabe

SECRETARIAT

Roy I. Jackson, Executive Director
Hiroshi Kasahara, Assistant Director

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

Established by Convention between Canada, Japan
and the United States for the Conservation of the
Fisheries Resources of the North Pacific Ocean

ANNUAL REPORT

FOR THE YEAR

1956

OFFICES:
209 Wesbrook Building
University of British Columbia
Vancouver 8, B. C., Canada

LETTER OF TRANSMITTAL

The Chairman of the International North Pacific Fisheries Commission presents his compliments to the Contracting Parties and their Commissioners and has the honor to transmit herewith an Annual Report describing the activities of the Commission during the year terminating with the end of the Third Annual Meeting on November 16, 1956.

The Report is presented in compliance with Article III (1) (f) of the International Convention for the High Seas Fisheries of the North Pacific Ocean and Rule 14 (f) of the Rules of Procedure.

EDWARD W. ALLEN,

Chairman.

FOREWORD

This is the third consecutive annual report which has been issued by the International North Pacific Fisheries Commission since it was established by the coming into force of the International Convention for the High Seas Fisheries of the North Pacific Ocean upon exchange of ratifications between Canada, Japan and the United States on June 12, 1953. Preceding the first annual report (1954) there was issued the "Report of First Meeting" describing the actions taken by the Commission at its organizational meeting, February 1 to 12, 1954.

The Annual Report for 1956 consists of three parts: First, a report on the 1956 Annual Meeting by the Chairman of the Commission. Second, a report by the Commission's Executive Director on administrative activities during the year. Third, summaries of the research carried out in 1956 under the Commission's program and co-ordination by the various co-operating research organizations in the three nations.

The research program undertaken in 1956 was essentially an expansion and refinement of the broad investigations begun in 1955. Greatest attention was given to the problem specified in the Protocol to the Convention, which requires the Commission to determine if salmon originating in the streams of Asia mingle in the sea with salmon originating in the streams of North America. If the stocks are mixed the Commission must conduct studies to determine a line or lines which best divide salmon stocks from the two coasts. Twenty ocean-going research vessels took part in the work and excellent progress was made.

Studies of the king crab stocks of the eastern Bering Sea were continued by vessels of the United States and Japan in a joint program initiated under Article III (1) (c) (i) of the Convention. The work is going forward rapidly, although still in its early stages.

The annual reports of the Commission, beginning with this report, will cover the period from the end of one annual meeting to the end of the next and will be designated by the calendar year to which the contents of the report principally relate.

ROY I. JACKSON,

Executive Director.

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I. Report of the 1956 Annual Meeting

of the

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

November 12 - 16, 1956

1. Time and Place of Meeting.

The Third Annual Meeting of the International North Pacific Fisheries Commission was held in Seattle, Washington from November 12th to 16th, 1956. All sessions were held in the Olympic Hotel. The public was invited to the opening session. Seven plenary sessions, including the opening session, and two *in camera* sessions were held.

The Annual Meeting was preceded by several related meetings, including informal consultations of the scientific advisers to the various national sections, which began on October 31st; by meetings of the Standing Committee on Biology and Research, which extended through the week beginning November 5th, and by meetings of the Standing Committee on Finance and Administration, held on November 8th and 9th. Meetings of the standing committees and of other *ad hoc* committees were also held at intervals between the plenary sessions.

2. Participants.

A full complement of four commissioners was present from each of the three member countries—Canada, Japan and the United States. The commissioners were accompanied by advisers, experts, and in the case of the United States delegation, by members of their Advisory Committee. The total of accredited participants was 95, consisting of 19 delegates from Canada, 13 from Japan, 47 from the United States, 9 observers and 7 permanent and temporary members of the Secretariat. Of the four observers accredited to represent the U.S.S.R., two attended the meetings. The other observers were accredited to represent the International Commission for the Northwest Atlantic Fisheries, the International Pacific Halibut Commission, the International Pacific Salmon Fisheries Commission and the Inter-American Tropical Tuna Commission.

The officers and members of the Commission and of its standing committees and a complete list of all those accredited to participate in the Annual Meeting are given in Appendix I of this report.

3. Opening Session.

The first plenary session was held in a large meeting room at the Olympic Hotel and was open to the public. Several hundred persons attended. Chairman Edward W. Allen welcomed the guests and members of the delegations and introduced Mr. Joseph E. Gandy, President of the Seattle Chamber of Commerce, who delivered an address of welcome. Mr. Gandy extended the greetings of the City of Seattle and the Chamber of Commerce to the Commission and spoke of the importance of the Commission's work to the economy of the three nations.

Mr. Koh Chiba, speaking for the delegation from Japan, expressed pleasure at the opportunity of again meeting with colleagues from Canada and the United States. He pointed out that the North Pacific Convention is based on belief in the principle that the effective conservation of fisheries resources can be carried out within the concept of the free sea, through co-operation among the interested nations and the employment of intelligent and scientific conservation measures. Progress in this direction by the Commission had been significant.

Mr. George R. Clark, speaking for the Canadian delegation, stated that the Commission, although a young organization, had already undertaken a tremendous program of scientific fisheries research on a scale unmatched elsewhere in the world. He stressed the value of continued research co-operation, co-ordination and understanding in carrying out the obligations imposed on the Commission by the Convention.

The opening address on behalf of the United States delegation was made by Mr. Milton E. Brooding. It was felt that considerable progress had been made in the study of ocean habits of salmon and that, although the basic concern of the United States on this subject continues, research at the present pace should soon provide the basis for a proper judgement on the problem assigned to the Commission. Mr. Brooding also expressed pleasure at the continued growth of understanding and goodwill within the Commission.

The Chairman of the Commission, Mr. Edward W. Allen, outlined the history and principles of international conservation of fishery resources and the relationships and responsibilities of commission members and scientists in this regard. He complimented the Commission on its unprecedented achievements in its brief span of activities to date.

At the conclusion of the opening session it was determined that attendance at subsequent sessions during the annual meeting would be limited to accredited participants, as listed in Appendix I of this report.

4. The Agenda.

The provisional agenda, which had previously been reviewed by the national sections in conformity with the Rules of Procedure, was adopted as prepared. The agenda is attached to this report as Appendix II.

5. Procedure for the Meeting.

The Commission adopted the following resolution relating to attendance at its meetings:

> "The first plenary session of annual meetings of the Commission shall be open to the public unless otherwise decided by the Commission. All non-public meetings of the Commission and meetings of its standing committees shall be open to guests and observers who have been invited by the Commission, except meetings which may be held *in camera.*"

A committee consisting of the Chairman and one commissioner from each national section, with the assistance of the Secretariat, was designated to arrange for preparation of press releases.

6. Consideration of Administrative Matters.

a. Report of the Chairman and Secretary.

The Chairman submitted the printed *Annual Report for the Year 1955* to the Commission, which accepted the report.

The Secretary of the Commission, Mr. Iwao Fujita of Japan, during the course of the meeting submitted to the Commission the following reports received from the governments of Canada and the United States:

From Canada:

1. *Report of the Salmon Stocks of the Pacific Coast of Canada, With Reference to Articles III (1) (a) and IV of the International Convention for the High Seas Fisheries of the North Pacific Ocean.*

2. *Report on North American Halibut Stocks, with reference to Articles III (1) (a) and IV of the Internatonal Convention for the High Seas Fisheries of the North Pacific Ocean.*

3. *Report on Canadian Herring Stocks, with reference to Articles III (1) (a) and IV of the International Convention for the High Seas Fisheries of the North Pacific Ocean.*

From the United States:

Report of the United States of America Concerning the Management of Certain North Pacific Salmon, Halibut and Herring Stocks With Reference to Article III (1) (a) of the International Convention for the High Seas Fisheries of the North Pacific Ocean of 1952.

These reports had been prepared and submitted by the Canadian and United States governments in response to a resolution adopted by the Commission at the 1955 Annual Meeting. The Commission received the reports, subject to later action. The purpose for which the reports were prepared and the procedure adopted by the Commission for their subsequent handling are described below in Section 8 of this report, "Implementation of the Provisions of the Convention."

b. Report of the Executive Director.

The Commission received the report submitted by its Executive Director dealing with activities of the Secretariat in administrative matters and coordination of research. The Director's report, which contains a record of the Commission's actions in the interval between the 1955 and 1956 Annual Meetings, has been condensed for publication and appears as Part II of the Annual Report of the Commission for 1956.

c. Report of the Committee on Finance and Administration.

The Commission has a Standing Committee on Finance and Administration which studies and makes recommendations to the Commission on matters indicated by its name. Membership of the Committee consists of one commissioner and one adviser from

each national section with the Director and Assistant Director as *ex officio members*. The Chairman was Mr. Roger T. Hager of Canada; a complete list of members is given in Appendix I.

The Committee met for two days during the week prior to the Annual Meeting and continued its work during the intervals between the plenary sessions. Its report and recommendations, which were adopted by the Commission may be summarized as follows:

i. The Committee approved the report of the auditors for the fiscal year ended June 30, 1956 and recommended its approval by the Commission. Expenditures by the Secretariat totalled $36,561.58 (Canadian funds) for the period. The accounts and auditor's report are appended to the Director's report, which forms Part II of this Annual Report.

ii. The Committee recommended changes in the Rules of Procedure to make the terms of office of Commission officers begin at the conclusion of each annual meeting and end at the adjournment of the subsequent annual meeting. The portion of Rule of Procedure 3 which specified that annual meetings be held not less than two weeks before the terms of office expired was deleted. (Copies of the revised Rules of Procedure and Financial Regulations will be prepared and distributed by the Secretariat at a later date.)

iii. The Committee recommended acceptance of the generous offer of the Honorable James Sinclair, Minister of Fisheries on behalf of the Dominion Canada, to make available office accommodation for the Commission's Secretariat. The offices, which were offered on a permanent and free basis, are to be located in a new building which will be constructed on the campus of the University of British Columbia for the Technological Station of the Fisheries Research Board of Canada. Designation of Vancouver, British Columbia as the permanent site of the Commission's headquarters was also recommended.

iv. The Committee recommended that each national section undertake to provide a comprehensive summary report on the nature and results of the scientific investigations made by its related research agencies under the Commission's research program each year. The summary reports are to be published in the Commission's annual report after the Commission has approved the manuscript for publication. It is understood that the views expressed in any research report are not necessarily those of the Commission, unless so stated, since publication should not be delayed until all material submitted can be fully evaluated by the Commission. A similar procedure was adopted for material submitted and approved for publication in future scientific bulletins of the Commission. The annual report is to cover the period from the end of one annual meeting until the end of the next.

v. The Committee recommended approval of staff policies proposed by the Executive Director with regard to annual leave, home leave, sick leave and costs of travel at the beginning and end of employment. Payment of home leave travel expenses not oftener than once in three years for staff members and their dependents was approved. Other administrative recommendations called for continued preparation of newsletters by the staff, broadening the scope of staff bonding, insuring the Commission's equipment and defining the authority of the staff with respect to attendance at meetings concerned with fisheries matters.

vi. The Committee recommended amendment of the Financial Regulations to provide that budget estimates and budget payments be made in the currency of the country in which the headquarters is located.

vii. The Commission adopted the following budget for costs of operation of its headquarters during the fiscal year beginning July 1, 1957:

1. Personal Services	$24,280
2. Travel	6,000
3. Transportation of Things	200
4. Communications	1,200
5. Rents and Utilities	1,500
6. Other Contractual Services	3,000
7. Supplies	1,200
8. Equipment	1,000
9. Cost of Annual Meeting	850
TOTAL (Canadian Funds)	$39,230

viii. The Committee presented a budget forecast totalling $48,700, Canadian funds, for the fiscal year beginning July 1, 1958 with the following understandings: (a) that this amount represents the maximum that will be requested, (b) that the forecast is intended for the guidance of the national sections in conformity with Financial Regulations 3.4 and 3.7 and will not be considered for adoption by the Commission until the next annual meeting.

ix. The Committee discussed a retirement pension plan being considered by the governments of Canada and the United States for employees of international fisheries commissions in which these governments participate. Further information will be obtained and distributed in order to enable this Commission to consider the question of participation at its 1957 Annual Meeting, if it so desires.

x. Arrangements were made to have the Executive Director prepare and submit a report on penalties in use by the three Contracting Parties for violations of the provisions of the Convention.

xi. The Committee recommended that the Fourth Annual Meeting begin on November 4, 1957 and that a prior meeting of the Committee on Finance and Administration begin on October 31, 1957.

xii. The Committee approved the Director's report to the Commission insofar as its contents related to the functions of the Committee and recommended its acceptance by the Commission.

xiii. The Commission requested and received from the Committee detailed recommendations on procedures to be followed for obtaining and submitting information and reports required under various articles of the Convention. The recommendations are technical and procedural in nature and will not be summarized here.

xiv. The Committee recommended that the Secretariat publish a small booklet containing the Convention, Rules of Procedure and Financial Regulations, in both official languages and also that a system of numbering and indexing meeting documents be developed.

xv. Finally, the Committee recommended that at future annual meetings, there be only one official reception, to be arranged for by the host national section.

7. Report of the Committee on Biology and Research.

The Standing Committee on Biology and Research met in Seattle for the week preceding the plenary sessions. The meeting of the full Committee was preceded by a four-day meeting of its scientist members for the purpose of demonstrating, comparing and standardizing techniquqes of investigation. All meetings were held in meeting rooms kindly made available by the United States Fish and Wildlife Service at its Montlake Laboratory. The Committee also met between plenary sessions during the week of the Annual Meeting. The membership of the Committee is given in Appendix I of this report.

The Commission's research program continues to be concentrated on two principal questions: *First,* in accordance with the Protocol to the Convention, an investigation of the waters of the Convention area to determine if there are areas in which salmon originating in the rivers of Canada and the United States intermingle with salmon originating in the rivers in Asia. If such areas are found the Commission is to conduct suitable studies to determine a line or lines which will best divide salmon of Asiatic origin from salmon of North American origin. *Second,* to study the king crab stocks of the eastern Bering Sea, at present fished by Japan and the United States, to determine if joint conservation measures are required.

The outline of the basic research program to accomplish these objectives was developed at the Commission's first Annual Meeting in 1954 and is given in the published report of that meeting. Investigations began in 1955 and continued on an intensified and unprecedented scale in 1956. The studies are being conducted by research organizations of the three participating countries, the Commission being charged by the Convention to utilize the technical and scientific services of official agencies of the Contracting Parties and their political sub-divisions, insofar as feasible. The Commission itself is given the basic responsibility to conduct the required studies and to report and make recommendations to the Contracting Parties on problems assigned by the Convention.

The Committee on Biology and Research reviewed the results of research conducted to date and concluded that, although results are still preliminary and incomplete, they are sufficient to show that the various lines of research together give promise of leading to a successful solution of the problems set by the Protocol. In addition the Committee reported progress in the development of many techniques for the study of salmon distribution and movement and for the identification of salmon stocks.

Detailed summaries of research conducted for the Commission by each fisheries research organization form Part III of this Annual Report. In addition the Commission's Executive Director has combined information from the separate summaries to present a composite record of achievements in terms of the Commission's program. In view of these comprehensive reports on the progress of investigations, which begin on page 21, only general information on past investigations will be given here. It is of interest to note that twenty ocean-going research vessels shared the task of conducting Commission research in the great expanse of the Northern North Pacific Ocean and the Bering Sea in 1956. Thirteen of these vessels were primarily concerned with studying the distribution of salmon and collecting specimens for studies to determine their continental origin. Three vessels undertook the work of tagging adult and juvenile salmon, with additional tagging being done on some of the exploratory vessels. Four vessels conducted oceaographic investigations in the "salmon waters" of the North Pacific. Incidental oceanographic studies were conducted by many of the exploratory fishing vessels as well.

It should be noted that two of the thirteen vessels studying the distribution of salmon were actually part of a tuna investigation based in Hawaii. Their work on salmon, while incidental to their principal function, illustrates the degree of co-ordination and co-operation being achieved.

Approximately sixty thousand salmon were caught by the exploratory fishing vessels—many of these fish being frozen for later intensive studies of their morphology, meristic characters, parasites, biochemistry, physiology, age, growth, species, diet, scale patterns and other characteristics which might be indicative of their continental and racial origin.

In addition approximately fourteen thousand additional salmon were collected from the high seas commercial fisheries of Japan and the land-based salmon fisheries of the United States and Canada. These specimens, combined with thousands of additional sets of measurements, scales and other data will provide a frame of reference for analysis of the origin of the high seas stocks.

Techniques of capture and tagging of salmon on the high seas have been most highly developed by the United States scientists and returns from the 7371 salmon tagged and released by these vessels in various high seas locations are being received from American, Japanese and Russian sources, although drawing of conclusions at this stage would be premature.

King crab research in the eastern Bering Sea was again conducted by scientists from Japan and the United States, under a co-ordinated program. Since Canada does not participate in the fishery, that country has not taken an active role in the investigation. Little is known of the abundance, age and growth, life history and migrations of the king crab. While data are being accumulated rapidly from the commercial fishery, special research cruises and tagging operations, no decision on whether or not there is a need for joint conservation measures can yet be reached.

Program for 1957

The Committee on Biology and Research considered the program of research in the light of progress already made and made recommendations for activities in 1957 which are quoted below. Co-ordination of research plans will be completed at an interim meeting of the Committee scheduled to be held in Tokyo in March, 1957.

Oceanography.

"The Committee recognizes the importance of a knowledge of the oceanography of the North Pacific to an understanding of the distribution and movements of salmon, and recommends the continuation and intensification of oceanographic research. In particular, surveys should be made in mid-winter and mid-summer, and surveys should be so integrated as to cover the entire area of the salmon's distribution, including the central portions which are of special interest to the protocol problem. The Committee believes that surveys should be planned as oceano-

graphic projects and carried out by specially equipped vessels and by personnel specially trained in oceanographic techniques and experienced in sea work. Such specific oceanographic researches can be valuably supplemented by observations incidental to fishing operations. In order to obtain integration of oceanographic surveys and to provide for thorough and critical interpretation of results, the Committee stresses the need for full exchange of data and for discussions between oceanographers. In particular, opportunity for thorough discussion of plans should be provided by a meeting in the spring of 1957.

High Seas Fishing by Research Vessels.

"The Committee stresses the importance of continuing the program of high seas fishing by research vessels to provide samples for study to determine the distribution of salmon stocks of various river origins. The desirability of learning the occurrence of salmon in winter is recognized because it would help us understand salmon distribution and movements generally. The Committee believes, however, that the need for exploratory fishing in winter is less urgent than in summer, and that it could be planned more advantageously after better knowledge of oceanographic conditions in winter is obtained. The planning of fishing operations in the summer should take account of the different distributions and movements of salmon of various ages. In order to facilitate comparison of results the gear used in exploratory fishing should be uniform and, failing this, the catches of different gears (e.g. meshes of gill-nets) should be compared experimentally. Detailed plans for fishing by research vessels should be kept flexible until results of analysis now in progress indicate more clearly the samples required for various racial studies.

Tagging.

"The Committee recommends the continuation and intensification of the tagging of salmon to discover the movements of various stocks. The Committee noted the success of the methods used by United States investigators (especially the capture of salmon by seines and the careful handling of the live fish). The Committee recommends experiments to improve tagging from gill-nets and also experiments with still other methods for capturing salmon for tagging, with a view to making use of the types of vessels available. The Committee stresses the need for tagging salmon farther from land and for careful but flexible planning of tagging operations.

Identification of Stocks.

"The Committee noted the great progress in the study of the characteristics of various stocks by the several methods used and recommends the continuance and intensification of work in this field. The importance was stressed of providing adequate samples from the high seas as well as from inshore areas on both sides of the Pacific. In particular the morphometric and meristic studies, the scale studies and the parasitological studies are already yielding results which promise to be valuable to a solution of the Protocol problem, and these studies have definite needs for extensive samples in 1957. The Committee noted that serological, osteological and paper chromatography techniques also have promise and recommends a continuation of efforts in these fields. The detailed needs of all these studies for samples in 1957 should be reconsidered carefully in the spring in the light of progress to that time.

Program of Research on King Crab.

"The Committee recommends an intensification of research on the king crab in view of the importance of the fishery and the lack of knowledge necessary to obtaining the maximum continued yield. The need for basic research on the life history of the species was stressed. It was also urged that the present program of statistical studies and tagging be continued and that it be integrated effectively by the thorough and prompt exchange of data."

The Committee received from the Secretariat a compilation of statistics of important fisheries in the Convention area during 1955. The compilation had been prepared as a sample to allow study of its adequacy as to form and content before proceeding with preparation of material from other years. The Committee deferred action on the question until the interim meeting to allow inclusion of additional material.

The Committee recommended that detailed plans of research for all participating groups should be made at the 1957 interim meeting. The Committee also stressed the importance of exchanging data on all aspects of the Commission's research program as promptly and fully as possible. In order to permit interpretation of all phases of the research program

by the scientists of the three countries, it is necessary that actual data, as well as analyses and conclusions, be made available to them.

The report of the Committee on Biology and Research, as summarized herein, was adopted by the Commission at its sixth plenary session. The Commission also adopted a resolution recommending that the Contracting Parties implement the Commission's research program for 1957 to the fullest extent practicable.

8. Implementation of the Provisions of the Convention.

During the course of the Annual Meeting the Commission reviewed progress in fulfillment of the terms of the Convention. The principal activities which the Commission is required to carry out and its accomplishments in each endeavour are summarized below:

(a) The Protocol Problem.

The Protocol to the Convention requires the Commission to determine if salmon originating in the streams of Asia mingle in the sea with salmon from North American streams and, if so, to determine a line or lines which best divide these stocks and to show that the new line or lines divide the salmon more equitably than the provisional lines specified in the Annex of the Convention.

For two years the Commission has conducted an intensive investigation of every conceivable and practicable approach to a solution of this problem. Results, while necessarily preliminary and incomplete, give promise of leading to a successful solution. During 1956, as mentioned previously, twenty ocean-going research vessels from the three countries ranged over the entire area of "salmon water" in the North Pacific. Part III of this Annual Report consists of summaries of the accomplishments of this tremendous research program. Many of the most able and experienced salmon research experts in the three countries have taken a continuing part in the planning and execution of the Commission's program.

The diversified attack on the Protocol question involves the use of racial studies in morphometry and meristics, parasitology, serology, scale analysis, biochemistry, direct studies of movements by tagging, extensive oceanographic investigations and analysis of records of catches by research and commercial vessels. The breadth of the approach is expected to give reliability to the Commission's conclusions and recommendations.

(b) The King Crab Investigation.

Under Article III (1) (c) (i) of the Convention the Commission has undertaken a study of the king crab stock of the eastern Bering Sea, at the request of the United States, to determine if joint conservation measures are needed. This fishery is carried on by Japanese and United States fishermen. The investigation began in 1955 and continued in 1956. It involves a species and stock about which there is very little scientific information. Techniques of investigation have had to be developed and tested more or less simultaneously with their application.

Co-operative planning of the program of king crab studies, co-operation in execution of the work, exchange of research data and the assistance and advice of those fishing king crabs in this area have been responsible for substantial progress in this undertaking. The Committee on Biology and Research has recommended an intensification in the program of research on king crab in view of the importance of the fishery and the lack of knowledge necessary to obtaining the maximum continued yield. The need for basic research on the life history of the stock was stressed. It was also urged that the present program of statistical studies and tagging be continued and that it be integrated effectively by the continued and prompt exchange of data.

Details of the king crab investigation are given in the summary reports of research by the United States and Japan in Part III of this report.

(c) Abstention.

The North Pacific Fisheries Convention provides that, under certain specified conditions, one or more of the member nations will refrain from fishing stocks of fish which are being fully utilized by one or more of the other member nations. It was agreed in the Convention that in the case of certain stocks of fish, originally specified for abstention in the Annex, no determination or recommendation as to whether such stock continued to qualify for abstention should be made for five years after the Convention entered into force, i.e. before June 12, 1958.

At its 1955 Annual Meeting the Commission adopted the following resolution to establish a procedure relative to the qualifications for continued abstention on the stocks of fish specified in the Annex:

"In order to enable this Commission to carry out its responsibility for determining whether stocks of fish specified in the Annex continue to qualify for abstention pursuant to Article III of the Convention, the following procedure is proposed: the Commission should request each Contracting Party which is managing, or participating in the management of, an abstained stock of fish, to submit to the Commission at the 1956 Annual Meeting, a report, with supporting data, concerning the management of such stock of fish, giving attention particularly to the requirements for abstention. The Commission would then have the opportunity of studying these reports and data and request and receive any needed supplementary data at the 1957 Annual Meeting, following which it would study the entire body of information in time to make its determination at its first Annual Meeting following the fifth anniversary of this Convention in 1958."

At the 1956 Annual Meeting, conforming to the above resolution, the United States and Canada each submitted to the Commission reports dealing with stocks of fish under abstention. Representatives of Canada and the United States outlined the contents of the reports to the Commission. Following presentation of the outlines, a temporary committee appointed to study the questions of procedure for future handling and consideration of the reports made the following recommendations, which were adopted by the Commission:

"(a) The Commission at this current Annual Meeting establish an Ad Hoc Commitee to consist of one Commissioner from each National Section who may be accompanied by experts or advisers.

"The Executive Director and/or the Assistant Executive Director should be instructed to act as the Secretariat of the Ad Hoc Commitee.

"The National Sections as soon as possible should advise the Executive Director of the name of their Commissioner who will serve on the Ad Hoc Committee together with their experts and advisers.

"(b) The Ad Hoc Committee shall make an initial study of the reports submitted by Governments in accord with the decision made at the 1955 Annual Meeting of the Commission.

"(c) The Ad Hoc Committee shall meet during the year at a specified time after the conclusion of the present Commission meeting.

"The meeting of the Ad Hoc Committee should be held in Tokyo either immediately before or immediately after the contemplated interim meeting of the Committee on Biology and Research. The purpose of this meeting of the Ad Hoc Committee is to give the Committee an opportunity to jointly study the reports; to obtain to the extent possible on-the-spot clarification of obscure points, if any, and, in conformity with the resolutions adopted by the Commission at its 1955 Annual Meeting, to determine whether or not further information should be requested.

"(d) If it is decided by the Ad Hoc Committee that further information were required, the Committee might recommend to the Commission that with respect to readily accessible information it immediately request the appropriate Government to submit such information to the Commission prior to the 1957 Annual Meeting. The Commission could act upon such recommendations by mail. The additional information which might be required shall be submitted to the Commission for transmittal to the National Sections as far in advance as practicable of the 1957 Annual Meeting.

"(e) The Ad Hoc Committee may make such other recommendations to the Commission for action at the 1957 Annual Meeting regarding additional information as it considered appropriate.

"(f) The Ad Hoc Committee shall continue to be established until such time as otherwise determined by the Commission.

"(g) In order to avoid confusion with other Committees it is suggested that the Ad Hoc Committee should be known as the 'Ad Hoc Committee for Study of Reports Submitted Under Article III (1) (a) or some other appropriate name."

Arrangements for subsequent meetings for this committee and others are described in Secton 10 of this report.

(d) Procedure.

The Commission instructed its Standing Committee on Finance and Administration to review and report on the procedures to be followed with respect to all articles of the Convention except for Article III (1) (a), which was dealt with by the temporary committee described above. The standing committee analyzed procedures already established, recommended some changes, clarified other cases and confirmed established procedure in some cases. Because the recommendations are technical in nature and not of general interest they are not described here. The minutes of the 1956 Annual Meeting record the recommendations as adopted by the Commission.

9. Other Matters.

Mr. George R. Clark, member of the Canadian National Section of the Commission and Deputy Minister of Fisheries for Canada, reported to the Commission on a conference on Fraser River pink salmon held in October, 1956 by representatives of Canada and the United States. Mr. Clark recognized the interest of the Commission in matters of fishery conservation in the North Pacific Ocean. He stated that the conference had agreed to a protocol to the Sockeye Salmon Fisheries Convention providing for the inclusion of the pink salmon stocks in the Convention area as a responsibility of the International Pacific Salmon Fisheries Commission. Approval of the governments concerned was being awaited.

Representatives of Japan reviewed the recently-concluded Convention between Japan and the U.S.S.R concerning the high seas fisheries of the Northwest Pacific Ocean at an specially-arranged gathering.

Dr. K. I. Panin, observer for the U.S.S.R. at the Annual Meeting and Director of the Pacific Institute of Fisheries and Oceanography at Vladivostok, spoke on the topic of Soviet fisheries research in Far Eastern waters at a meeting arranged for that purpose.

10. Election of Officers.

Following the system of rotation given in the Rules of Procedure, Mr. George R. Clark of Canada was elected as Chairman of the Commission for the ensuing year. Mr. Iwao Fujita of Japan was elected as Vice-Chairman and Mr. Edward W. Allen of the United States was elected as Secretary. In accordance with the amendment to the Rules of Procedure made at this meeting, the new officers took office immediately upon adjournment of the 1956 Annual Meeting. Their terms will end at the conclusion of the 1957 Annual Meeting.

For the same term, and also following the rotation system, Mr. John H. Clawson of the United States was chosen as the Chairman of the Committee on Biology and Research. Mr. Iwao Fujita of Japan was elected as Chairman of the Standing Committee on Finance and Administration. Membership of the two standing committees was left unchanged for the next year except that the name of the adviser for the United States on the Finance and Administration Committee will be given at a later date. All other members of the two standing committees for 1957 are as listed in Appendix I of this report.

The Canadian and Japanese National Sections announced the names of their representatives on the newly-formed Ad Hoc Committee for Study of Reports Submitted Under Article III (1) (a) as follows: For Canada, Commissioner-member, Mr. George R. Clark, Commissioner-adviser, Mr. James C. Cameron, advisers, Messrs A. W. H. Needler, M. P. Shepard, K. S. Ketchen. For Japan, Commissioner-member, Mr. Iwao Fujita, Commissioner-adviser, Mr. Sakari Masuda, advisers, Messrs, M. Fujinaga and K. Kawakami. The United States deferred announcing the names of its representatives until a later date.

11. Future Meetings.

The Commission agreed on the following schedule of meetings for the coming year:

The Ad Hoc Committee for the Study of Reports Submitted Under Article III (1) (a) will meet in Tokyo for approximately one week, beginning on March 11, 1957.

The Committee on Biology and Research will meet in Tokyo for approximately one week, beginning on March 18, 1957.

The Committee on Biology and Research will meet in Vancouver, Canada for the week prior to the Annual Meeting, beginning on October 28, 1957.

The Committee on Finance and Administration will meet in Vancouver, Canada prior to the Annual Meeting, beginning on October 31, 1957.

The Fourth Annual Meeting of the Commission will be held in Vancouver, Canada beginning on November 4, 1957.

The Third Annual Meeting of the International North Pacific Fisheries Commission closed on November 16, 1956 with expressions of gratification and appreciation by all delegations for the spirit of understanding and the outstanding record of accomplishments to date.

APPENDIX I

List of Participants

OFFICERS OF THE MEETING

CHAIRMAN
Edward W. Allen, United States

VICE-CHAIRMAN
George R. Clark, Canada

SECRETARY
Iwao Fujita, Japan

MEMBER GOVERNMENTS

CANADA

Commissioners.

John M. Buchanan,
Vancouver, B. C.
James Cameron,
Madeira Park, B. C.
George R. Clark,
Ottawa, Canada
Roger T. Hager,
Vancouver, B. C.

Advisers.

A. W. H. Needler
R. E. Foerster
J. L. Kask
A. J. Whitmore
C. N. Senior
M. P. Shepard
K. S. Ketchen
F. Neave
J. I. Manzer
L. Margolis
J. P. Tully
A. J. Dodimead
D. Foskett
R. Le Brasseur
H. B. Hachey

JAPAN

Commissioners.

Iwao Fujita,
Tokyo, Japan
Koh Chiba,
Tokyo, Japan
Sakari Masuda,
Tokyo, Japan
Kenkichi Nakabe,
Tokyo, Japan

Advisers and Experts.

M. Fujinaga
S. Yoshikawa
J. Inagawa
K. Kawakami
H. Ohki
G. Yamada
K. Taguchi
H. Tominaga

Interpreter.

S. Mizota

UNITED STATES

Commissioners.

Milton E. Brooding,
San Francisco, California
Edward W. Allen,
Seattle, Washington
John H. Clawson,
Anchorage, Alaska
John L. Farley,
Washington, D.C.

Advisers.

C. E. Atkinson
W. C. Herrington
D. P. Loker
A. J. Suomela
W. M. Terry
W. F. Thompson
L. A. Walford

Advisory Committee.

C. L. Anderson
W. C. Arnold
V. E. Brock
H. F. Cary
R. S. Croker
L. Fitzpatrick
D. Gilbert
M. C. James
G. Johansen
R. C. Kallenberg
H. E. Lokken
C. K. Phenicie
M. Phister
T. F. Sandoz
R. J. Schoettler
L. Wakefield
J. Waugh

Experts.

F. C. Cleaver
R. H. Fleming
R. Fredin
F. Fukuhara
J. Gharrett
M. G. Hanavan
A. Hartt
B. Jones
T. Koo
D. R. McKernan
T. Miyahara
K. H. Mosher
L. Nakatsu
A. E. Peterson
R. Ridgway
W. Royce
R. P. Silliman
R. Ting
J. R. Uzman

OBSERVERS

Union of Soviet Socialist Republics.
K. I. Panin
R. S. Semko
M. I. Drozdov
V. V. Krivoshchekov
V. Loosanoff (interpreter)

International Commission for the Northwest Atlantic Fisheries.
George R. Clark

International Pacific Salmon Fisheries Commission.
R. J. Schoettler
Loyd A. Royal

Inter-American Tropical Tuna Commission.
Gordon W. Sloan

International Pacific Halibut Commission.
H. A. Dunlop
F. H. Bell

SECRETARIAT

Permanent.
Roy I. Jackson
Executive Director
Hiroshi Kasahara
Assistant Director
Marion E. McMullen
Secretary

Temporary.
C. J. Burner
W. Miller
Iwao Matsushita
Toshiji Kanaya

MEMBERSHIP OF STANDING COMMITTEES

Standing Committee on Finance and Administration

CANADA
Commissioner — Roger T. Hager, Chairman
Adviser — George R. Clark

JAPAN
Commissioner — Iwao Fujita
Adviser — Sakari Masuda

UNITED STATES
Commissioner — John L. Farley
Adviser — Donald P. Loker

SECRETARIAT — Roy I. Jackson, Hiroshi Kasahara

Standing Committee on Biology and Research

CANADA
Commissioner — James Cameron
Advisers — A. W. H. Needler, Convenor; R. E. Foerster

JAPAN
Commissioner — Kenkichi Nakabe, Chairman
Advisers — Motosaku Fujinaga; Kisaburo Taguchi

UNITED STATES
Commissioner — John H. Clawson
Advisers — William F. Thompson; Lionel A. Walford

SECRETARIAT — Roy I. Jackson, Hiroshi Kasahara

APPENDIX II

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

Agenda

as adopted for the

ANNUAL MEETING — 1956

Seattle, Washington — November 12 to 16, 1956

1. Call to order by the Chairman.
2. Introductions.
3. Addresses of welcome.
4. Responses.
5. Adoption of Agenda.
6. Submission of lists of experts and advisers by the national sections.
7. Establishment of procedures of the meeting.
   (a) Attendance at meetings.
   (b) Press releases.
8. Report by the Chairman.
9. Report by the Secretary.
10. Report by the Executive Director including:
    (a) Accounts.
    (b) Budget.
    (c) Other matters.
11. Consideration of the research program.
    (a) Progress in 1956.
    (b) Program for 1957.
    (c) Statistics.
12. Consideration of the implementation of the provisions of the Convention.
    (a) Article III, Section 1 (a).
    (b) Protocol to the Convention.
    (c) Reports required under Article III (1) (c) (iii).
    (d) Articles VIII and III (1) (e).
    (e) Article X, Section 2.
    (f) Articles III (1) (d) and IX (2).
    (g) Other articles.
13. Report of the Committee on Biology and Research.
14. Consideration of administrative and fiscal matters.
    (a) Accounts and Auditor's report.
    (b) Matters which may require amendment of the Rules of Procedure or the Financial Regulations.
        (i) Change of date of Commission meetings and related change of term of office of Commission officers.
        (ii) Change of currency of budget estimates and contributions.
    (c) Annual Report policy.
    (d) Permanent headquarters.
    (e) Policy for home leave for staff members.
    (f) Budgets for fiscal years beginning July 1, 1957 and July 1, 1958.
    (g) Other business.
15. Report of the Committee on Finance and Administration.
16. Adoption of formal recommendations to the Contracting Parties for:
    (a) Research programs.
    (b) Contributions.
    (c) Reports and information.
    (d) Other matters.
17. Election of officers and determination of membership of standing committees.
18. Date and place of next Annual Meeting.
19. Other business.
20. Adjournment.

II. Administrative Report for 1956

by the Executive Director

ROY I. JACKSON

This report contains information on administrative and fiscal matters and records of research co-ordination and other activities of the headquarters staff of the International North Pacific Fisheries Commission. It covers the period from the end of the 1955 Annual Meeting to the close of the 1956 Annual Meeting.

1. ADMINISTRATIVE MATTERS

1.1. Accounts and Audit.

The record of receipts and expenditures by the Commission's Secretariat for the fiscal year ended June 30, 1956 is appended to this report in combination with the report of the auditors, Peat, Marwick, Mitchell and Co. The auditors found the accounts and procedures in good order.

Receipts from the three Contracting Parties for operation of the Commission's headquarters during the 1955-56 fiscal period totalled $36,950.32 in United States funds. Each government contributed equally, ignoring an overpayment of 32 cents. Contributions were made in U.S. funds, in accordance with Financial Regulation 5.4; however, accounts and expenditures were in terms of the currency of the headquarters country, i.e. Canada. For this reason the appropriations are subject to the varying exchange rates between Canadian and United States funds. During the fiscal year ended June 30, 1956, the exchange rate resulted in a discount of $388.74 or 1.05% in converting U.S. currency payments into Canadian currency.

The first semi-annual contribution for headquarters operation in the 1956-57 fiscal period has been received from each Contracting Party. These payments of $6,418.33 each, were converted into Canadian currency as received, at an average discount of 2.06%, representing a loss of $397.15. In accordance with the decision of the Commission at the 1955 Annual Meeting, salaries of permanent staff members have been paid in amounts equivalent to the budget limits established in United States currency beginning on December 1, 1955.

1.2. Working Capital Fund.

The Working Capital Fund was established shortly after being authorized at the 1955 Annual Meeting in a separate bank account in the amount of $5,864.75, Canadian funds. No use of the Working Capital Fund has been made to date. At the auditor's suggestion the fund is established in an interest-bearing savings account; income will be credited to the general fund.

1.3. Votes.

Since the 1955 Annual Meeting the Commission has voted by correspondence on several questions. The decisions made thereby and the dates on which the decisions were announced by the Chairman or otherwise took effect are given below:

a. Draft minutes of the two final plenary sessions of the 1955 Annual Meeting were circulated to the national sections by mail for approval. By February 10, 1956, approval had been received from all sections.

b. All national sections agreed to an indefinite postponement of an interim meeting of the Committee on Biology and Research which had been scheduled to convene on February 6, 1956 in Honolulu. The postponement was announced by the Chairman on February 1, 1956.

c. All national sections approved a request from the U.S.S.R. that observers from that nation be allowed to attend the 1956 Annual Meeting of the Commission. The Chairman issued an invitation on behalf of the Commission on April 24th, 1956.

d. A policy for content, preparation and approval procedure for the Annual Report for 1955 was suggested by the Secretariat and approved by all national sections. The Chairman announced the approval of the proposal under date of April 24, 1956.

e. Approval was given by all national sections for a proposed meeting of the scientist members of the Committee on Biology and Research in Seattle on October 31, 1956, preceding the meeting of the full committee, which was to begin on November 5. Approval was announced by the Chairman of the Committee on September 19, 1956.

f. The Commission approved of issuance of invitations to the following organizations to be represented by observers at the 1956 Annual Meeting. Approval had been received from all national sections by September 10, 1956 and invitations were sent on September 13, 1956.

International Commission for the Northwest Atlantic Fisheries.
International Pacific Salmon Fisheries Commission.
International Pacific Halibut Commission.
Inter-American Tropical Tuna Commission.
Food and Agriculture Organization of the United Nations.

1.4. Membership of the National Sections.

Mr. Masao Okai of Japan resigned as a Commissioner on October 16, 1956 and was succeeded by Mr. Sakari Masuda on the same date. No other changes in the membership of the Commission have taken place since the 1955 Annual Meeting.

Mr. Milton C. James was appointed as a member of its Advisory Committee by the United States Section as of February 15, 1956. Mr. C. K. Phenicie was added as a member of the United States' Advisory Committee during the 1956 Annual Meeting.

1.5. Reports.

During the period under review, bound copies of the minutes of the 1954 and 1955 Annual Meetings were distributed to all who participated in the 1955 meetings. A detailed report on research operations and data collected by Japan under the INPFC program in 1955 was received by the Secretariat, translated and distributed to the United States and Canadian scientists concerned in the spring of 1956. An outline of Japan's research program for 1956 was received and distributed in late summer. The manuscript for the Annual Report for 1955, including research reports from each government, had received approval for publication from all national sections by October 12, 1956. Printed copies in English were distributed during the 1956 Annual Meeting. The Japanese-language version will be printed as soon as possible.

Newsletters have been prepared and distributed in recent months in order to keep all members of the Commission informed of progress in all phases of the work they have jointly undertaken.

1.6. Interim Meeting.

The interim meeting of the Committee on Biology and Research, scheduled to be convened in Honolulu on February 6, 1956 was indefinitely postponed, by agreement of all national sections.

In the opinion of the Secretariat the research work of the Commission would benefit markedly if such a gathering could be held each year, for the primary purpose of bringing the scientist members together in a working session. The program of research is complex and the area is great; continued closer contact would help in the efficient execution of agreed programs and avoid the development of misunderstandings. If an interim scientific working session is to be of maximum value it must be held in late winter or early spring; late enough so that maximum knowledge of the previous year's research findings will be available, and early enough so that detailed research plans for the coming season can still be modified and co-ordinated.

1.7. Staff Matters.

The Secretariat has been fully occupied since the last annual meeting in carrying on the administrative and co-ordinating activities for which it is responsible. The volume of statistical and biological report material that is being handled has made it necessary to ask for more clerical assistance for the future and thus arrive at a more nearly balanced staff. An increase in the allotment for temporary personnel was made by the Commission at the 1956 Annual Meeting.

A policy for providing periodic home leave for staff members and their families was recommended by the Secretariat and adopted at the 1956 Annual Meeting. This is an established practice in similar inter-continental international organizations. Home leave will be arranged in conjunction with travel for Commission purposes in order to minimize the cost.

1.8. Budget Estimates.

In accordance with the Financial Regulations (amended) budget estimates for the 1957-58 fiscal year were distributed to all national sections 60 days prior to the annual meeting. In addition a budget forecast for 1958-59 was prepared and distributed for discussion and information but not for adoption

until the 1957 Annual Meeting. The 1958-59 estimates visualize employment of a biologist-statistician to assist in handling the statistical and other routine duties which are expected to be in greater volume by that time. This will allow the Director and Assistant Director time for more frequent and closer contact with the agencies conducting the research program.

The question of whether budget appropriations should continue to be made in United States funds or be made in the currency of the headquarters' country was reviewed at this meeting. The Commission decided to make future budget contributions payable in the currency of the country where the headquarters is located, i.e., Canada.

1.9. Other Meetings Attended.

Mr. George R. Clark, Canadian Commissioner, represented this Commission at the 1956 Annual Meeting of the International Commission for the Northwest Atlantic Fisheries. Since the last Annual Meeting members of the Secretariat have attended or have been invited to attend meetings of several international and other fisheries bodies, including the following: International Pacific Salmon Fisheries Commission, International Pacific Halibut Commission, Pacific Marine Fisheries Commission, American Fisheries Society, Alaska Science Conference.

2. THE RESEARCH PROGRAM

2.1. The Role of the Commission.

Throughout its text the International Convention for the High Seas Fisheries of the North Pacific Ocean assigns to the Commission definite responsibilities for the conduct, promotion, co-ordination, reporting and interpretation of scientific research. From among the many specific instructions on these matters in the Convention the following may be quoted or paraphrased:

(1) **To "... promote and co-ordinate the scientific studies** necessary to ascertain the conservation measures required to secure the maximum sustained productivity of fisheries of joint interest to the Contracting Parties . . ." (Preamble)

(2) **To study** the stocks in the Annex to determine if they continue to qualify for abstention. [Article III (1) (a)].

(3) **To study,** on request of a Contracting Party, any stock of fish in the Convention area, the greatest part of which is being harvested by one or more of the Contracting Parties, to determine if such stock qualifies for abstention. [Article III (1) (b)].

(4) **To study,** on request, any stock of fish substantially exploited by two or more Contracting Parties, and not covered by an existing conservation agreement, to determine if joint conservation measures are needed. [Article III (1) (c) (i)].

(5) **To compile and study** statistical and other records and information supplied, upon request, by the member nations. [Article III (1) (e)].

(6) **To consider** evidence based on scientific research in determining if stocks of fish qualify for abstention. [Article IV (b) (i)].

(7) **To ". . . investigate** the waters of the Convention Area to determine if there are areas in which salmon originating in the rivers of Canada and of the United States of America intermingle with salmon originating in the rivers of Asia . . ." (Protocol to the Conventon).

In each instance above the words which give the Commission responsibility for conducting or considering scientific research have been emphasized. The research assignments are exceedingly broad in scope and often unique in character. To carry out these tasks successfully the Commission must undertake scientific investigations of the highest order as expeditiously as is practicable.

The general program of research is determined by the Commission itself, after it has given consideration to its responsibilities under the Convention, to the relative urgency of the various problems and to the funds and material resources available to the participating national research bodies. The Commission relies on its Standing Committee on Biology and Research for advice and recommendations on the points and methods of attack on its scientific problems, i.e., for the development of a detailed research program, and expects the Committee to report on details of progress and recommend modification of plans for future research.

The Committee on Biology and Research is composed of one Commissioner and two advisers from each national section, with the Executive Director

and the Assistant Director of the Commission's staff as *ex officio* members. The adviser-members are outstanding fisheries scientists directing the various research agencies to which the Commission has entrusted the conduct of its investigations, as explained in the following paragraph. On behalf of the Commission, the Committee co-ordinates planning, techniques, items of observation, areas of observation and exchange of samples and data to the maximum extent possible.

The Commission is instructed by Article III (3) of the Convention to utilize the technical and scientific services of the official agencies of the member nations and their political sub-divisions in performing these functions, insofar as feasible. The Commission has arranged to do so, and relies on the fisheries research organizations of its member governments to execute and report on the research assignments allotted from its general research program.

2.2. The Role of the Commission's Staff.

The Commission has not assigned any phase of the actual conduct of its investigations directly to its own staff, research being carried out, in a manner beyond criticism, by the skilled and well-equipped research agencies of the member governments. Insofar as research is concerned, then, the role of the Commission's staff must be to assist the Commission, in every desirable way, to achieve the objectives stated in the preamble to the Convention: ". . . to promote and co-ordinate the scientific studies necessary to ascertain the conservation measures required to secure the maximum sustained productivity of fisheries of joint interest to the Contracting Parties . . ." The staff must also aid in seeing that the Commission is kept informed of the progress of the extensive investigations required under the other Articles and the Protocol to the Convention. In general it must endeavour to keep a free and efficient flow of data, samples, techniques and personal contacts between researchers and to assist the Commission and its working committees on a year-round basis. A description of the functions of the staff must emphasize the words "promote," "co-ordinate" and "report."

An interim meeting of the Committee on Biology and Research, scheduled for February 6, 1956 unfortunately could not be held. As a result much of the detail of research co-ordination in 1956 was carried out through correspondence and through staff visits to the various research agencies. The writer spent a month in Japan immediately prior to the beginning of the 1956 field investigations for the purpose of clarifying and co-ordinating procedures, records, sample collections and innumerable other matters inherent in the formative stages of such a diversified and far-flung program.

The Assistant Director took part in a meeting of research vessels and scientists of the three countries which took place at Adak, Alaska, in late June when overlapping cruise plans made a rendezvous feasible. Samples and data were exchanged and research methods and equipment were compared by the research workers who actually carry out the field investigations. Later Dr. Kasahara continued on a comprehensive tour of Alaska's salmon fisheries and salmon research centres. The Adak meeting brought a new level of co-ordination and understanding into the Commission's work and had much practical value.

Throughout the year there has been a continued flow of correspondence between the national correspondents, scientists and the Secretariat, relating to details of the research program and the collection and interchange of samples, data, reports and statistics. The Commission's staff function as arrangers and expediters of such exchanges and attempt to keep the movements of information on schedule and in accordance with Convention requirements and Commission policies.

2.3. Statistics for the Commission.

At the 1955 Annual Meeting the Commission adopted a recommendation that the member governments be requested to supply various kinds of statistical information concerning the catches, escapements and fishing effort of the salmon, halibut, herring and king crab fisheries in the Convention area. The Secretary of the Commission subsequently transmitted the request to the governments of the three Contracting Parties and received an affirmative reply in all cases. Each country appointed a person or agency to work with the Secretariat on fulfilling the Commission's requirements. Of necessity, the arrangements have proceeded slowly and there were a number of gaps in the data which were presented to the Commission at the 1956 Annual Meeting. The data presented covered 1955 only and, as far as

possible, incorporated the additions and changes recommended by the Committee on Biology and Research at the 1955 Annual Meeting and adopted by the Commission. The form and scope of the 1955 compilation will be discussed with the Committee and arrangements made, if possible, for securing of the missing information.

The Secretariat has set the 1958 Annual Meeting as a target date for submission to the Commission of a historically complete compilation of the statistics of the important fisheries of joint interest in the Convention area. Every effort will be made to procure and compile the data, have it checked by the appropriate national agencies and submit it by that date. Experience has clearly demonstrated that more clerical assistance is required to handle the data — the budget estimates being submitted have provided for this.

2.4. Appreciation.

The Secretariat wishes to express its appreciation for the co-operation and courtesy offered by all the national sections and the various scientists and research agencies during the past year. It is our hope to further increase our contact with all phases of the research program during the coming year and to aid in every possible and proper way to promote, coordinate and report on the investigations undertaken by the Commission.

APPENDIX I

PEAT, MARWICK, MITCHELL & CO.
CHARTERED ACCOUNTANTS
410 SEYMOUR STREET
VANCOUVER 2
B. C.

AUDITOR'S REPORT TO THE COMMISSION

We have examined the balance sheet of the International North Pacific Fisheries Commission as of June 30, 1956 and the statements of income and expenditure and receipts and disbursements for the year ended on that date and have obtained all the information and explanations we have required. Our examination included a general review of the accounting procedures and such tests of accounting records and other supporting evidence as we considered necessary in the circumstances.

In our opinion the balance sheet and statements of income and expenditure and receipts and disbursements are properly drawn up so as to exhibit a true and correct view of the state of the affairs of the Commission at June 30, 1956 and the results of its operations for the year ended on that date, according to the best of our information and the explanations given to us and as shown by the books of the Commission.

PEAT, MARWICK, MITCHELL & CO.,
Chartered Accountants.

Vancouver, B. C.
August 23, 1956.

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

Statement of Assets and Liabilities
June 30, 1956
(Stated in Canadian Funds)

ASSETS

General funds:			
Cash in bank			$ 1,564.87
Deposit with United Air Lines			425.00
			$ 1,989.87
Working capital fund:			
Cash in bank			5,864.75
Equipment, at cost		$ 3,857.74	
Less accumulated depreciation		568.04	
			3,289.70
			$ 11,144.32

LIABILITIES

General funds:			
Accounts payable and accrued expenses			$ 1,989.87
Advances from contracting parties for working capital fund			5,864.75
Amount equivalent to expenditure on equipment less depreciation, per contra:			
Amount at June 30, 1955		$ 1,822.70	
Additions during year		2,035.04	
		$ 3,857.74	
Deduct:			
Depreciation provided in previous year	$ 182.27		
Depreciation in current year	385.77		
		568.04	
			3,289.70
			$ 11,144.32

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

Statement of Income and Expenditures
Year ended June 30, 1956
(Stated in Canadian Funds)

Income:		
Contributions from contracting parties (U.S. funds $36,950.32)		$ 36,561.58
Expenditures:		
Personal services	$ 21,382.74	
Travel	5,994.74	
Transportation of things	283.48	
Communications	1,068.92	
Rent and utilities	1,500.00	
Other contractual services	2,764.47	
Supplies	818.77	
Equipment	2,035.04	
Cost of annual meeting	713.42	
		$ 36,561.58

STATUS OF APPROPRIATIONS

	Budget Appropriations U.S. Funds	Appropriations as Modified by Transfers U. S. Funds (Note 1)	Appropriations as Modified by Transfers Canadian Funds (Note 2)	Expenditures
Personal services	$ 22,700.00	$ 21,610.09	$ 21,382.74	$ 21,382.74
Travel	6,000.00	6,058.48	5,994.74	5,994.74
Transportation of things	100.00	286.49	283.48	283.48
Communications	650.00	1,080.29	1,068.92	1,068.92
Rent and utilities	1,500.00	1,515.95	1,500.00	1,500.00
Other contractual services	3,000.00	2,793.86	2,764.47	2,764.47
Supplies	600.00	827.48	818.77	818.77
Equipment	1,800.00	2,056.68	2,035.04	2,035.04
Cost of annual meeting	600.00	721.00	713.42	713.42
	$ 36,950.00	$ 36,950.32	$ 36,561.58	$ 36,561.58

Notes:

1. The small difference in total appropriations arose from an overpayment by one of the contracting parties.
2. Converted at the average rate of exchange realized.

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

Statement of Receipts and Disbursements
Year ended June 30, 1956
(Stated in Canadian Funds)

Receipts:		
Contributions from contracting parties (U.S. funds $36,950.32)		$ 36,561.58
Disbursements:		
Expenses:		
Personal services	$ 21,382.74	
Travel	5,994.74	
Transportation of things	283.48	
Communications	1,068.92	
Rent and utilities	1,500.00	
Other contractual services	949.60	
Supplies	818.77	
Office equipment	2,035.04	
Cost of annual meeting	713.42	
		34,746.71
Excess of receipts over disbursements, represented by increase in bank accounts:		
Balance June 30, 1956	$ 7,429.62	
Balance June 30, 1955	5,614.75	
		$ 1,814.87

III. The Research Program of the North Pacific Fisheries Commisison

A. COMPILATION OF RESEARCH SUMMARIES FOR 1956

Roy I. Jackson

The program of research being carried out by the International North Pacific Fisheries Commission relates to two principal problems: The first of these is assigned to the Commission in the Protocol to the International Convention for the High Seas Fisheries of the North Pacific Ocean. The Protocol states, in part:

> "The Commission to be established under the Convention shall, as expeditiously as practicable, investigate the waters of the Convention area to determine if there are areas in which salmon originating in the rivers of Canada and of the United States of America intermingle with salmon originating in the rivers of Asia. If such areas are found the Commission shall conduct suitable studies to determine a line or lines which best divide salmon of Asiatic origin and salmon of Canadian and United States of America origin, from which certain Contracting Parties have agreed to abstain in accordance with the provisions of Article V, Section 2, and whether it can be shown beyond a reasonable doubt that this line or lines more equitably divide such salmon than the provisional lines specified in Sections 1 (c) and 2 of the Annex. In accordance with these determinations the Commission shall recommend that such provisional lines be confirmed or that they be changed in accordance with these results, giving due consideration to adjustments required to simplify administration."

The second research problem undertaken by the Commission is a study of the king crab stocks of the eastern Bering Sea to assist in determining if joint conservation measures are needed. The king crab fishery in that area of the high seas is conducted by fishing vessels from Japan and the United States. On February 6th, 1954, the United States requested that this study be undertaken, in accordance with the provisions of Article III (1) (c) (i) of the Convention.

The program which the Commission has adopted to provide scientific evidence for use in arriving at solutions to these two problems is outlined in the Report of the First Annual Meeting, 1954. The program will be summarized here, for convenient reference.

Program of Research on Salmon

(Oncorhynchus nerka, O. gorbuscha, O. keta, O. kisutch, O. tschawytscha)

I. **Studies of the offshore distribution of salmon,** to obtain data on intermingling and movements of salmon stocks on the high seas by means of:

   A. Collection and analysis of records of commercial catches on the high seas.

   B. Special cruises by research vessels for scientific data and samples.

II. **Studies to determine the continent of origin of salmon occurring on the high seas** by means of:

   A. Morphological and meristic studies based on samples and data collected throughout the marine and freshwater range of salmon.

   B. Biochemical and physiological studies, based on samples obtained throughout the range of Pacific salmon.

   C. Studies of the parasites of Pacific salmon to determine if certain species of parasites or relative intensities of infection are characteristic of stocks of various origins and can be used as indicators of the origin of salmon occurring on the high seas.

III. **Studies of salmon movements** by means of tagging.

   A. To develop and apply techniques for capturing and tagging salmon in viable condition on the high seas and to develop a co-ordinated program for the recovery of tags throughout the Convention area, thus providing direct evidence of salmon movements.

   B. To develop and execute a program of tagging juvenile salmon in coastal areas, prior to their movement to offshore and high seas waters.

IV. **Oceanographic investigations of the North Pacific** in order to:

A. Relate the distribution of Pacific salmon on the high seas to physical and chemical characteristics of the marine environment and to evaluate the effects of fluctuating conditions therein.

B. To associate the distribution of the oceanic plankton and other organisms serving as food for Pacific salmon with the distribution of the salmon stocks and with physical and chemical variations in the sea.

Program of Research on King Crab
(Paralithodes camtchatica)

A. **Compilation and analysis of data collected aboard commercial fishing vessels,** in order to deduce the abundance and extent of the stocks from fishing effort and catch data and to determine the species composition of the catch and the sex, maturity, size and shell condition of the king crab catch.

B. **Identification of stocks** through comparisons of measurements of body parts and proportions in samples of the catches. Results of tagging experiments (Item E, below) will assist studies of differential distribution and behaviour of various stocks.

C. **Relation of currents to distribution and dispersal of the young king crabs** through oceanographic observations and studies of plankton samples to trace the transport of larvae.

D. **Growth and age determinations** through development and use of a tag or mark that will be retained during the moulting process and through raising of crabs in captivity.

E. **Study of movements by tagging** by scientists operating from commercial fishing vessels and/or research vessels.

F. **Determination of the rates of fishing and natural mortalities** utilizing results of tagging experiments and, eventually, analyses of age and size composition of the catch.

EXECUTION OF THE RESEARCH PROGRAM

The Commission is given complete responsibility in the Convention for the programming and execution of the research necessary to fulfill the requirements of the various portions of the Convention. In performing its functions the Commission is enjoined by Article III (3) of the Convention to utilize, insofar as feasible, the technical and scientific services of, and information from, official agencies of the Contracting Parties and their political subdivisions.

On this basis, the research and investigation required by the Commission has been, and continues to be, executed by the official fisheries research groups of the several national governments. These national bodies have, in some cases, arranged for specialized phases of the investigations to be conducted by others, including other governmental bodies, universities, private organizations and individual scientists. The Commission, after receiving the recommendations of its Standing Committee on Biology and Research, arranges to have the total research requirements for the year divided among the available research agencies and facilities for execution. Comprehensive arrangements for the co-ordination of investigations, standardization of methods, and exchange of data, samples and reports have been developed, but need not be described here.

Each year, under present practice, each national section of the Commission presents a summary report of the investigations conducted for the Commission by its related research agencies. These summary reports are published in the Commission's annual report—the summaries for 1956 are included in this volume. Since the three summaries necessarily give a somewhat piecemeal view of overall achievements under each section of the research program, there follows a further summary, combining information on progress by all research groups under appropriate headings from the research program. In this way a comprehensive view of progress can be presented. More detailed information may be obtained by reading the separate national reports.

PROGRESS IN RESEARCH — 1956

SALMON

I. STUDIES OF THE OFF-SHORE DISTRIBUTION OF SALMON TO OBTAIN DATA ON INTERMINGLING AND MOVEMENTS OF SALMON STOCKS ON THE HIGH SEAS by means of:

A. Collection and analysis of records of commercial catches on the high seas.

The Fisheries Agency of Japan presents information on the catch of salmon in 1956 by mothership operating in Pacific waters west of 175°W. longitude and east of Kamchatka in its summary report. The data include the catch by species, by week, by numbers, and by weight. An additional table describes the catch by month, by species, by area (2° latitude by 5° longitude), with data on the numbers of units of gillnets employed. High seas salmon catches by the United States and Canada form a relatively minor portion of their fisheries and take place in areas very close to coastal territorial waters; hence no separate data are presented for these fisheries.

B. Special cruises by research vessels for scientific data and samples.

Twelve research vessels from the three countries conducted studies of the offshore distribution of salmon and collected data and samples for studies of the question of continental origin of the stocks in 1956. All used drifting gillnets of varied mesh sizes as their primary fishing apparatus. The total period of operations covered approximately five months, beginning in late April and extending until late September.

The fishing stations actually occupied by the research vessels are shown in Figure 1. Most of the waters of the North Pacific Ocean and the Bering Sea in which salmon are found were covered by the cruises. Because of the vast extent of the area it was not possible to determine the relative distribution throughout the range with respect to time. A total of 59,300 salmon were taken by the research vessels, including 21,300 sockeye *(O. nerka)*, 5,800 pinks *(O. gorbuscha)*, 27,500 chum *(O. keta)*, 4,450 coho *(O. kisutch)* and 250 chinook *(O. tschawytscha)*. The catch data indicate that the five species are distributed more or less continuously from the American to the Asian coasts. It is also indicated that the southern limit of salmon distribution changed seasonally in 1956, being as far south as the vicinity of 41°N. latitude (at 165°W longitude) in late April and apparently shifting as far north as 49°N. in August, 1956 in the mid-ocean area south of the Aleutian Islands.

Catches by the research vessels indicate differences in distribution of the various species; for example chum salmon are distributed over a very wide area in moderate or heavy concentrations. Sockeye salmon concentrations are more restricted. The research catches indicated that immature sockeye and chum salmon were widely distributed over the northern waters of the North Pacific. Salmon of 30 cm. fork length could be taken in the smallest mesh sizes used, approximately 2.5 to 3 inches.

The catches of salmon by most of the research vessels were preserved aboard ship by freezing and later taken to shore laboratories. There they provided materials for use by the various groups of scientists engaged in studies of the continental origin of high seas salmon.

II. STUDIES TO DETERMINE THE CONTINENT OF ORIGIN OF SALMON OCCURRING ON THE HIGH SEAS.

A. Morphological and meristic studies.

Research agencies of the three countries engaged in carrying out the Commission's salmon investigations have devoted a major share of their efforts to the question of determining the continent of origin of high seas salmon. The program has concentrated on sockeye, pink and chum salmon. Chinook and coho are usually of relatively infrequent occurrence in the high seas catches. In addition to the frozen salmon retained from research vessel catchs, many thousands of sets of biometric measurements and scales were collected throughout the accessible portions of the marine and freshwater range of the genus.

The United States research workers have used a combination of seven meristic characters to study racial differences in a total sample of approximately 9,000 sockeye and chum salmon collected in 1955. Analysis of the nearly 24,000 salmon collected in 1956 is proceeding rapidly. Quoting from the United States research summary,

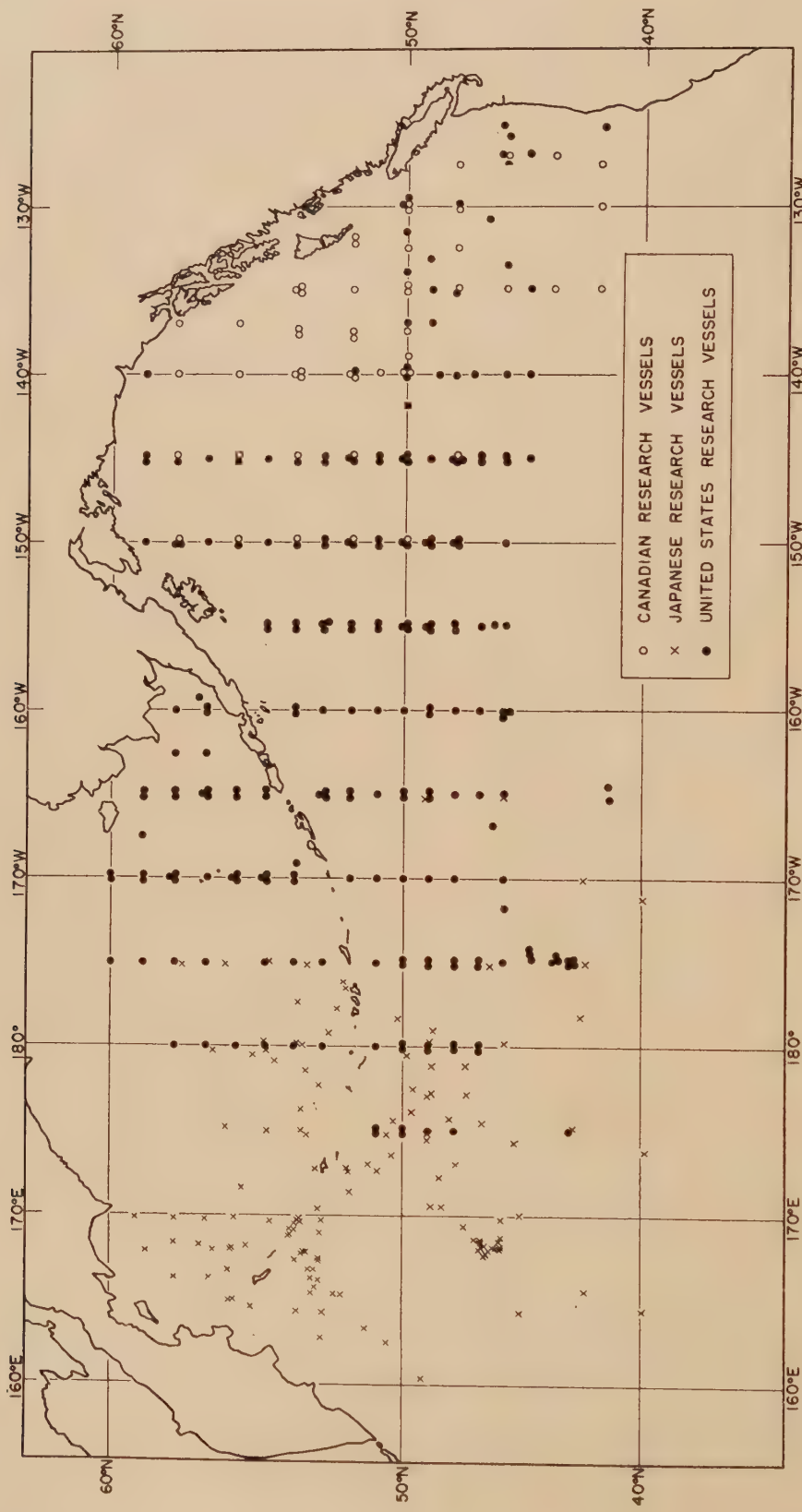

Fig. 1. Fishing stations actually occupied by the research vessels of the three countries, 1956.

> "Every method of analysis used to determine area of origin points to success in the separation of the Asian and North American stocks of salmon . . ."

The results from 1955, although most encouraging, make it clear that success in solving the problem will depend on increasing the scope and size of the samples of salmon. Strong efforts to greatly expand the sampling program were successful in 1956. The analysis of these more adequate samples, when completed, should add greatly to knowledge of continental origin of the high seas stocks.

Study of the various characteristics of the scale patterns of red salmon has resulted in assignment to correct areas of origin of 80 to 90% of the individual fish whose scales were examined on a test basis. This investigation will be expanded and applied to collections of scales from 1956 samples as they become available.

Canadian workers have undertaken studies of the osteology of Pacific salmon, using material collected throughout the North Pacific. The first phase, a description of the skeletal anatomy by species and of the changes which take place as maturity approaches, neared completion in 1956. The second phase, a search for differences in stocks of the same species but of different river origins, was started in 1956 but results are not yet available for reporting.

B. Biochemical and physiological studies.

Workers in the United States and Japan have developed and applied methods which measure significant serological differences between populations of salmon from different geographical regions. The techniques give promise of allowing determination of the origin of individual fish taken on the high seas, although much work in development of sera must be done before the methods can be applied on a mass field test basis.

Japanese scientists carried out preliminary studies of variations in the flesh color of both sockeye and chum salmon from various localities. The relationships of color differences to age, sex, length and weight are also being examined.

C. Studies of the parasites of Pacific salmon.

Samples of sockeye, pink and chum salmon collected by the three countries in 1955 were examined for parasites by workers in Canada and the United States. Preliminary results indicated that several species of parasites, through their presence or absence and/or relative abundance might be useful in determining the continental origin of salmon taken on the high seas. An enlarged program for collection of samples of salmon for parasitic studies was undertaken by all three countries in 1956. An attempt was made to collect 25 fish of each species from all North American coastal areas and from stations spaced at intervals of five degrees longitude across the North Pacific and the Bering Sea.

From approximately 1,500 sockeye and pink samples studied in 1955, including smolts, marine juveniles and adults, over 50 species of parasites were encountered, of which 45 were identified, at least generically. Those unidentified were of rare occurrence and the available specimens were in poor condition. Several of the species of parasites show promise of helping to distinguish the continental origin of stocks.

Ideally, for the purpose of distinguishing the origin of a salmon stock, a parasite should be of fresh-water origin, be retained throughout the life of the fish and should be of limited distribution. Of four species of parasites which infest sockeye in fresh-water and are retained throughout life, the Canadian workers report that only one, *Triaenophorus crassus,* has a distribution sufficiently limited to hold promise as a "living tag." Parasites acquired during marine life are being studied with particular care to determine if differences in their occurrence reflect onshore-offshore differences rather than differing continents of origin of the fish.

Chum salmon, being studied by United States parasitologists, have yielded 27 species of parasites thus far, of which three species are said to hold promise for distinguishing the continent of origin of high seas chums.

Results of the studies of parasites from the much larger collections of salmon made in 1956 are not yet completed. Japanese scientists also made preliminary studies of salmon parasites in 1956. When the total data for 1956 have been analysed a much clearer interpretation of the value of this promising approach for separating stocks will be possible.

III. STUDIES OF SALMON MOVEMENTS BY TAGGING.

All three member countries tagged salmon during 1956 for the purpose of making direct studies of the movements of salmon. Canada tagged 7,717 juvenile salmon during their early marine life in the Chatham Sound - Dixon Entrance area of the British Columbia coast. Beach seines and purse seines were used to capture the fish, predominantly pink salmon, and a tubular plastic "spaghetti" tag was used. Only five recoveries have been reported to date, the fish being too young to have entered the commercial fishery in 1956.

Japan tagged 1,188 salmon, principally sockeye and chum, during 1956 research vessel operations. The fish were caught by gillnets and tagged with a "harpoon" tag consisting of a barbed metal pin to which a plastic disc is flexibly attached. No recoveries had been reported to the date at which the report was written.

United States scientists carried out an extensive high seas salmon tagging program in 1956. Using specially-built purse seines for capturing fish in viable condition and employing carefully-developed equipment and techniques for handling them aboard the two vessels it was possible to tag 7,371 salmon, principally sockeye (3,403) and chums (3,637). Tagging operations took place principally along the Aleutian chain, extending as far west as Kiska Island. The period of operations extended from May 2 to September 14. Bad weather practically prohibited seining operations until June 7. As a result very few salmon were taken prior to that date and these mostly with gillnets.

The tags used were principally 1/16 inch diameter plastic tubes — the so-called spaghetti tag — passed through the cartilaginous body tissue beneath the dorsal fin and knotted. Plastic disc tags were used on approximately 1,000 fish. Of the total fish tagged 3,473 were estimated to be mature, i.e. destined to spawn within the year, and 3,898 were expected to spawn one or more years later.

Shortly after the end of 1956 the recovery of 161 tags had been reported. This comprises 4.6 per cent. of the tags applied to **mature** fish. Information on tagging and recovery locations is given in the United States summary. Additional recoveries are expected in 1957 from immature fish tagged in 1956.

IV. OCEANOGRAPHIC INVESTIGATIONS OF THE NORTH PACIFIC.

The summary report on oceanographic investigations by the United States in 1956 in its opening statement defines the relationship of oceanography to the Commission's problems and is worthy of being quoted here:

> "Exploration of the sea and the systematic surveys that are essential to the understanding of the distribution, abundance and migration of economically important fishes are arduous and expensive and must be carried out on a year-round basis if their true characteristics are to be understood. The value of such information lies in our ability to relate direct observations of the fishes to a background of information that may be called the 'geography' of the oceans. This geography is made up of a vast number of physical and chemical features that themselves directly affect the fishes or, what is more important, influence the type and abundance of food organisms available to the fish. Their geography is not directly related to latitude and longitude because the pattern of conditions is varying, changing with the seasons and differing from year to year. It is through a knowledge of such processes that the real value of oceanography will develop, that is, through an ability to predict how conditions will change with time and how these changes may affect the distribution and movements of the fish or what will be 'good' years or 'bad' years that may control the abundance or growth of the fish."

All of the vessels engaged in the Commission's research program made observations of sea temperatures and collected water samples at various depths throughout their cruises as a matter of routine. In addition, each of the three countries operated a special oceanographic research vessel in the area in 1956.

The data from these and available previous investigations of the area are being compiled, standardized and analyzed in order that the environmental factors influencing the distribution and movements of salmon, and other fish, in the North Pacific may be understood.

The distribution and abundance of plankton throughout the area is being studied and analysis of the stomach contents of the various species of salmon is being made in order to compare the food species

utilized with those actually available. It is still too early to generalize regarding the pattern of plankton distribution in relation to the physico-chemical oceanography or the distribution of salmon.

V. GENERAL.

Exchanges of data and of samples between scientists of the various groups working in the three nations were carried out actively during 1956. Samples of salmon for continental origin studies were collected from widely scattered areas of the high seas as well as from the coastal areas and spawning streams of North America and the island of Hokkaido. A special meeting was held in Seattle during October, 1956, at which salmon research workers from the three countries compared and standardized techniques of reading salmon scales.

Three Japanese and two United States research vessels met at Adak in the Aleutian Islands in July, 1956, to exchange salmon samples and to demonstrate and compare operating techniques. Various other scientists concerned with the Commission's program took part in this meeting.

KING CRAB

The Commission's program of investigation of the status of the king crab stocks is confined in area to the eastern Bering Sea. The objective is to determine if joint conservation measures should be undertaken by the Contracting Parties substantially exploiting the stocks, i.e., Japan and the United States. Investigations are being carried out by scientists of both countries. Canada does not participate in this fishery and therefore does not take an active part in the research program. The fishery in question takes place in waters north of the Alaska Peninsula between 160° and 164°W. longitude and northward to approximately 58°N. latitude.

A. Compilation and analysis of data collected aboard commercial fishing vessels.

During 1956 one Japanese mothership fished king crab commercially in the eastern Bering Sea. Crabs were caught in tangle nets set from small vessels, processing, principally canning, was carried out on the mothership. A biologist stationed aboard the mothership assisted in compilation of catch data and related information on depth, temperature, position, currents, units of gear used, sex, species, size and maturity of the catch. Two commercial fishing vessels from the United States used otter trawls to capture king crab in the same general area in 1956. The crabs were frozen aboard the fishing vessels. Data similar to those recorded by Japan were recorded for the United States operations.

B. Identification of stocks.

Measurements of the body parts of large samples of king crabs have been made—results of the analysis of these data have not yet been completed and reported. It is possible that different stocks, if present, within the area, can be identified by differing body proportions. Tagging programs now underway may also shed light on this question.

C. Relationship of current to distribution and dispersal of young king crabs.

Observations of currents in the fishing area have been carried out. However, data available to date are not sufficient to indicate the relationship of currents to the movements of young king crabs. Scattered observations of the distribution of young crabs have been made. Onshore-offshore movements are related to the breeding habits of the species.

D. Growth and age determinations.

Data on hand indicate that all king crabs do not moult annually; some have retained tagged shells through more than one year. A few crabs marked with a tubular plastic tag so affixed that it could be retained through moulting have been recaptured and have shown growth but the quantity of data available is not yet sufficient to permit conclusions concerning growth rates. It is suggested that the number of eggs carried by females is related to the age of the crab. The problem of growth and age determinations in king crabs is most difficult. In spite of several years of intensive investigations it is not yet possible to report much information on the subject.

E. Study of movements by tagging.

United States workers tagged approximately 4,000 king crabs in the eastern Bering Sea in 1956 and a small number of tags were affixed by Japanese researchers. The tag used in most of the United States work was a plastic tube "spaghetti" tag attached to the tissue beneath the posterior edge of the carapace in such a way that it could be retained through moulting. Preliminary analysis of the data

from the limited number of recaptures of tags placed in 1954, 1955 and 1956 indicates that there was mixing of crabs throughout the area now utilized by the fishery. Movements of 50 to 100 miles were not uncommon and crabs released at stations farthest from the fishery were well represented in the fishery.

Recovery effort has been uneven geographically because of the localized nature of the commercial fishery. All vessels tend to fish on the most concentrated stocks of crabs, which are unevenly distributed over the general fishing area.

F. Determination of rates of mortality.

Determination of the rates of natural and fishing mortalities depends upon knowledge of the abundance and age and growth characteristics of the population and on many other factors, all of which are at present imperfectly known for the king crab. For this reason little can be reported as yet on mortality rates of the king crab stock of the eastern Bering Sea.

B. A SUMMARY OF CANADIAN RESEARCH IN 1956 ON PROBLEMS RAISED BY THE PROTOCOL

In 1956 work was continued and extended on projects underway in 1955, including a study of the skeletal anatomy of salmon; an attempt to find parasites which will indicate the origin of salmon occurring on the high seas; tagging of small sockeye, pink and chum salmon to indicate migrations away from rivers of origin and the fisheries to which various stocks contribute; and co-operation in a study of the oceanographic background for salmon distribution. These appear as Items II A, II C, III 3, and IV 2 in the program of research on the problems raised by the Protocol adopted by the Commission in October, 1954. Work was initiated in 1956 on two additional items undertaken by Canada at the meeting of the Commission at Tokyo, October-November, 1955, namely, participation in high-seas fishing to sample salmon and in studies of scales to discover characteristics by which stocks of various origins may be distinguished.

Canada also co-operated in other parts of the program, (a) by supplying samples of sockeye, pink and chum salmon from inshore Canadian waters for use in other projects, including study of morphological and meristic characters and serological studies, and (b) by assistance in the recovery and reporting of tags.

Progress was made in 1956 in all aspects of the work and preparations have been made for continuation of all the above projects in 1957.

1. Sampling of Salmon on the High Seas.

During the summer of 1956, two chartered vessels, the *Key West II* and the *Challenger,* conducted salmon-fishing operations on the high seas of the northeast Pacific. The positions of fishing stations are shown in Figure 1. Catches and other data are summarized in Table 1.

Fishing was performed with gill-nets of four mesh sizes distributed in the following proportions: 5¼" - 3 shackles; 4½" - 1 shackle; 3¼" - 1 shackle; 2½" - 1 shackle. Each shackle was 50 fathoms long.

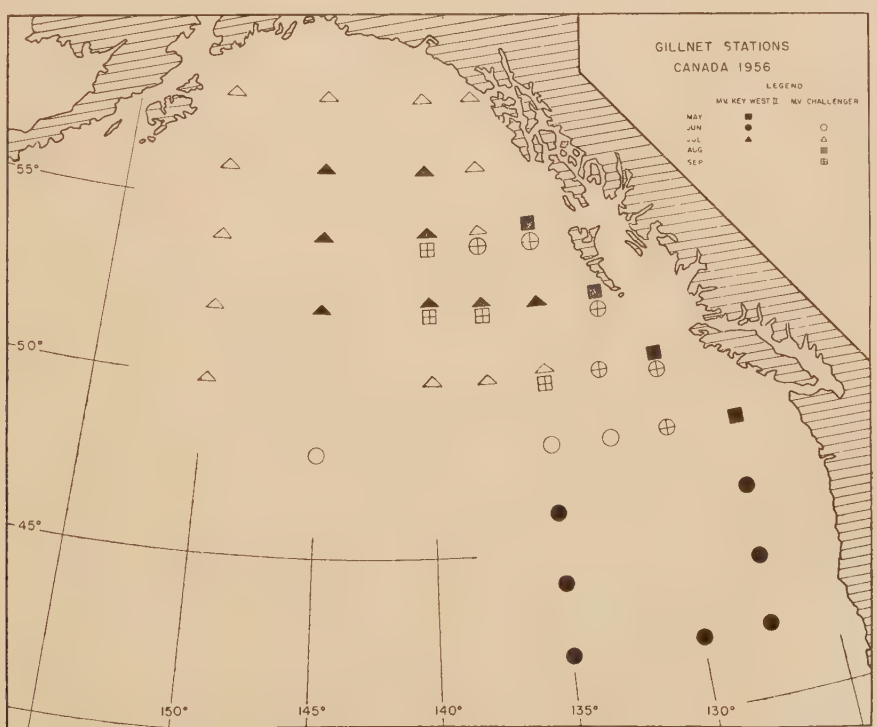

Fig. 1. Gillnet stations occupied by Canadian research vessels, 1956.

TABLE 1. Salmon catches in the northeast Pacific by Canadian research vessels in 1956.

Date	Position Lat. N.	Long. W.	No. of shackles	Fishing time (hr.)	Surface temp. (°C.)	Species Sockeye	Pink	Chum	Coho	Chinook	Total
					Challenger						
June 3	48°	132° 30′	6	8:15	10.8	—	13	—	3	—	16
4	48	135	6	10:00	9.6	1	—	1	2	—	4
7	48	145	6	10:30	7.6	3	1	1	3	2	10
July 8	54	137° 30′	6	10:00	11.5	1	—	3	5	—	9
9	56	137	18	9:00	12.0	9	4	34	18	1	66
10	58	137	18	6:30	11.0	21	20	31	10	—	82
11	58	140	18	7:15	11.0	16	5	12	10	—	43
12	58	145	18	6:45	12.0	18	24	1	21	—	64
13*	58	150	18	9:45	9.0	1	—	19	1	—	21
17	56	150	18	9:30	12.1	31	30	42	8	—	111
18	54	150	18	9:30	12.1	10	19	15	7	1	52
19	52	150	18	6:15	9.3	5	7	7	2	—	21
20	50	150	18	11:45	10.5	17	1	8	—	—	26
23*	50	140	18	11:30	13.0	—	—	—	—	—	0
24	50	140	18	12:15	12.5	—	—	—	—	—	0
25	50	137° 30′	18	11:45	13.0	—	—	—	—	—	0
26	50	135	18	12:00	13.5	—	—	—	—	—	0
Aug. 12	50	130	24	7:00	15.0	—	—	—	—	—	0
15	52	132	24	8:15	14.0	—	3	1	—	—	4
16*	54	135	24	5:45	12.5	—	1	—	—	—	1
22	54	135	24	12:00	14.0	—	56	55	17	—	128
23	54	137° 30′	24	9:30	14.0	—	1	—	—	—	1
25	50	132° 30′	24	8:00	16.0	—	—	—	—	—	0
26	48	130	24	6:00	18.0	—	—	—	—	—	0
Sept. 6*	54	140	24	7:45	12.9	—	1	—	—	—	1
7	54	140	24	10:45	12.9	—	—	6	—	—	6
8	52	140	24	8:30	13.0	—	—	—	—	—	0
9	52	137° 30′	24	11:45	14.0	—	—	—	—	—	0
10	50	135	24	8:15	14.3	—	—	—	—	—	0
					Key West II						
May 23	54	135	12	10:30	8.0	5	—	—	—	—	5
28	52	132	18	7:50	9.4	10	4	10	1	—	25
29	50	130	12	8:00	11.1	—	4	—	1	—	5
31	48	127° 30′	18	6:30	12.5	1	1	—	—	—	2
June 18	46	135	12	8:20	11.0	—	2	—	1	—	3
19	44	135	12	9:00	12.1	—	—	—	—	—	0
20	42	135	6	9:50	13.0	—	—	—	—	—	0
21	42	130	6	4:45	13.0	—	—	—	—	—	0
22	42	127° 35′	12	8:45	14.7	—	—	—	—	—	0
26	44	127	12	8:45	14.8	—	—	—	—	—	0
27	46	127	12	9:20	14.2	—	—	—	—	—	0
July 12	56	140	18	7:50	10.2	5	6	—	7	—	18
13	56	145	18	9:10	11.0	7	18	8	11	—	44
14	54	145	18	8:50	11.4	6	6	36	5	—	53
15	52	145	12	9:15	11.0	7	3	11	3	1	25
17	52	140	12	9:30	12.0	11	3	9	—	—	23
18	54	140	18	9:25	12.0	2	10	21	—	—	33
19	52	137° 50′	12	10:10	12.2	—	2	1	—	—	3
20	52	135	18	10:40	13.3	13	5	17	3	—	38
Total						200	250	349	139	5	943
Per cent.						21.2	26.5	37.0	14.7	0.5	99.9

* Day-time set.

TABLE 2. Salmon catch per unit of gear.

Mesh Size	Number shackles fished	Sockeye		Pink		Chum		Coho		Spring		Total Salmon Catch	
		No. fish	Catch per shackle	No. fish	Catch per shackle	No. fish	Catch per shackle	No. fish	Catch per shackle	No. fish	Catch per shackle		
2½″	134	35	.26	0	0	23	.17	12	.89	0	0	70	.52
3¼″	134	15	.11	33	.24	81	.60	7	.52	0	0	136	1.01
4½″	134	30	.22	94	.70	73	.54	28	.20	2	.01	227	1.69
5¼″	402	120	.30	123	.30	172	.42	92	.22	3	.007	510	1.26

TABLE 3. Length and weight of sockeye salmon caught in the northeast Pacific by Canadian research vessels, 1956, according to age and sex.

Age	Male				Female			
	Length (cm.)		Weight (kg.)		Length (cm.)		Weight (kg.)	
	Number measured	mean	Number weighed	mean	Number measured	mean	Number weighed	mean
2_1	—	—	—	—	2	34.5	2	2.1
3_1	2	41.5	2	2.9	4	51.0	4	1.9
3_2	21	39.7	18	1.0	14	39.5	11	1.2
4_1	1	60.0	1	3.8	1	61.0	1	3.8
4_2	40	53.1	39	2.4	40	56.6	39	2.5
4_3	3	44.7	3	1.4	—	—	—	—
5_2	10	61.7	8	2.9	16	59.4	15	3.2
5_3	5	59.0	5	3.1	10	55.1	10	2.5
6_3	3	61.0	3	3.4	4	60.3	4	2.8

TABLE 4. Age and sex composition of sockeye salmon caught in the northeast Pacific by Canadian research vessels, 1956.

Age	Male		Female		Sex unknown		Sexes Combined	
	No.	%	No.	%	No.	%	No.	%
2_1	—	—	2	1.0	—	—	2	1.0
3_1	2	1.0	4	2.0	—	—	6	3.0
3_2	21	10.5	14	7.0	3	1.5	38	19.0
3_3	—	—	—	—	1	0.5	1	0.5
4_1	1	0.5	1	0.5	—	—	2	1.0
4_2	40	20.0	40	20.0	3	1.5	83	41.5
4_3	3	1.5	—	—	—	—	3	1.5
5_2	10	5.0	16	8.0	1	0.5	27	13.5
5_3	5	2.5	10	5.0	—	—	15	7.5
6_3	3	1.5	4	2.0	—	—	7	3.5
?	4	2.0	4	2.0	8	4.0	16	8.0
All ages combined	89	44.5	95	47.5	16	8.0	200	100.0

TABLE 5. Length and weight of chum salmon caught in the northeast Pacific by Canadian research vessels, 1956, according to age and sex.

Age	Male				Female			
	Length (cm.)		Weight (kg.)		Length (cm.)		Weight (kg.)	
	Number measured	mean	Number weighed	mean	Number measured	mean	Number weighed	mean
2	21	38.3	19	0.8	30	37.6	26	0.7
3	94	53.4	91	2.2	71	52.8	71	2.1
4	35	62.5	36	3.0	67	57.9	64	2.9
5	1	61.0	1	4.1	2	59.0	1	3.8

TABLE 6. Age and sex composition of chum salmon caught in the northeast Pacific by Canadian research vessels, 1956.

Age	Male		Female		Sex unknown		Sexes Combined	
	No.	%	No.	%	No.	%	No.	%
2	21	6.0	30	8.6	8	2.3	59	16.9
3	93	26.7	71	20.3	7	2.0	171	49.0
4	36	10.3	66	18.9	3	0.9	105	30.1
5	1	0.3	1	0.3	—	—	2	0.6
?	1	0.3	7	2.0	4	1.1	12	3.4
All ages combined	152	43.6	175	50.1	22	6.3	349	100.0

TABLE 7. Length and weight of pink salmon caught in the northeast Pacific by Canadian research vessels, 1956, according to sex.

Sex	Length (cm.)		Weight (kg.)	
	Number measured	mean	Number weighed	mean
Male	124	49.7	120	1.81
Female	101	47.9	97	1.67

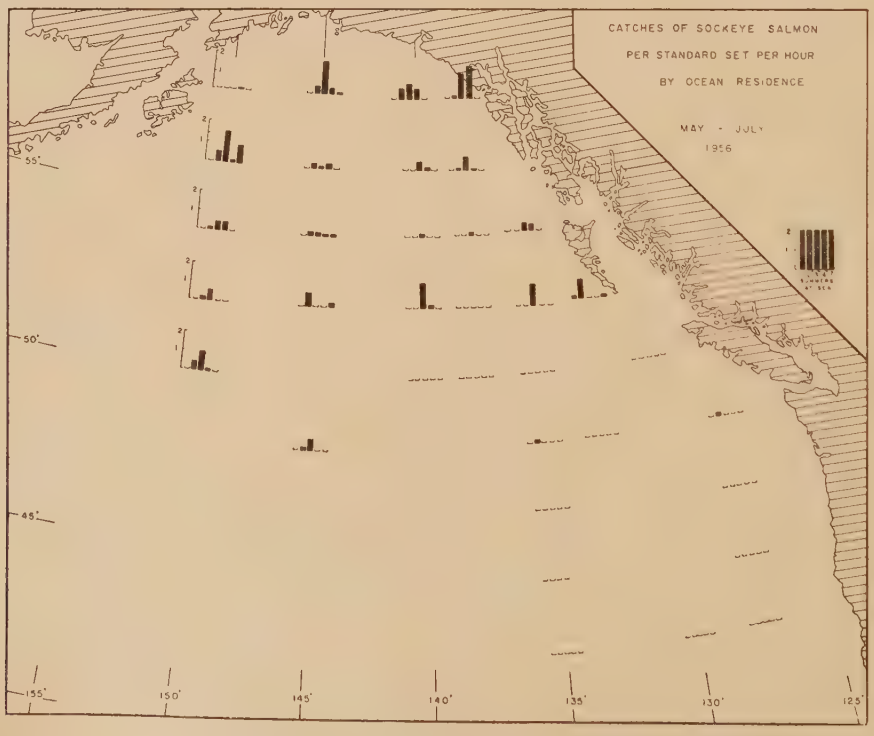

Fig. 2. Sockeye salmon catches during May - July, 1956.

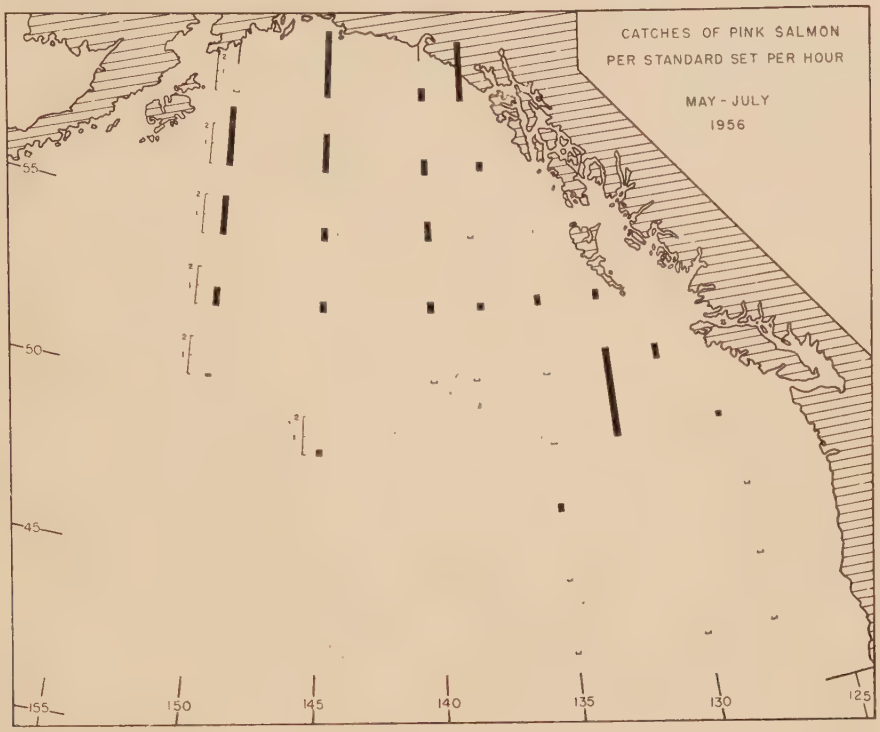

Fig. 3. Pink salmon catches during May - July, 1956.

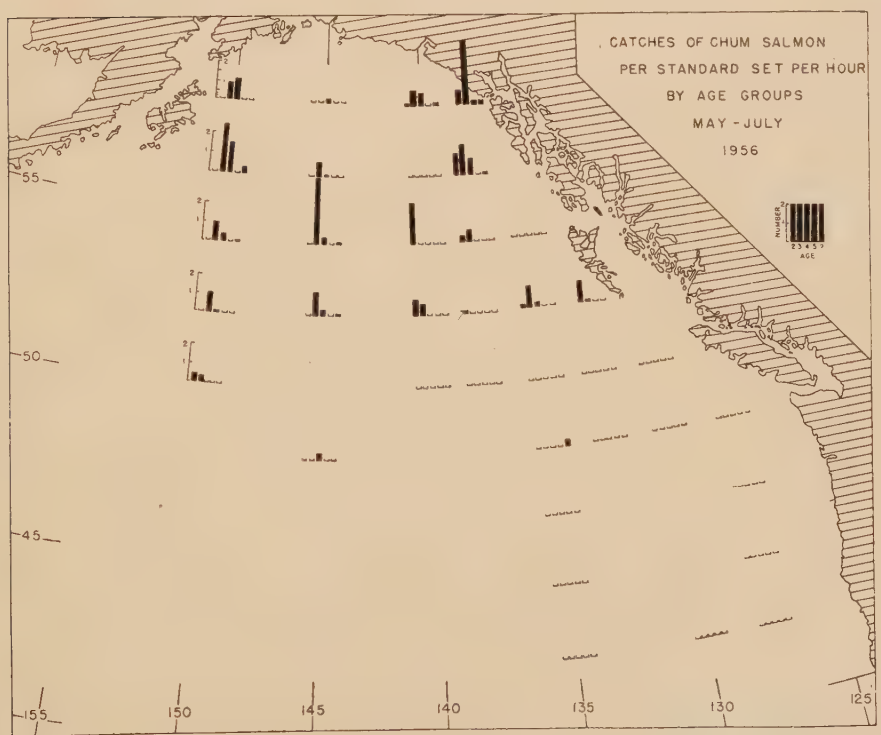

Fig. 4. Chum salmon catches during May - July, 1956.

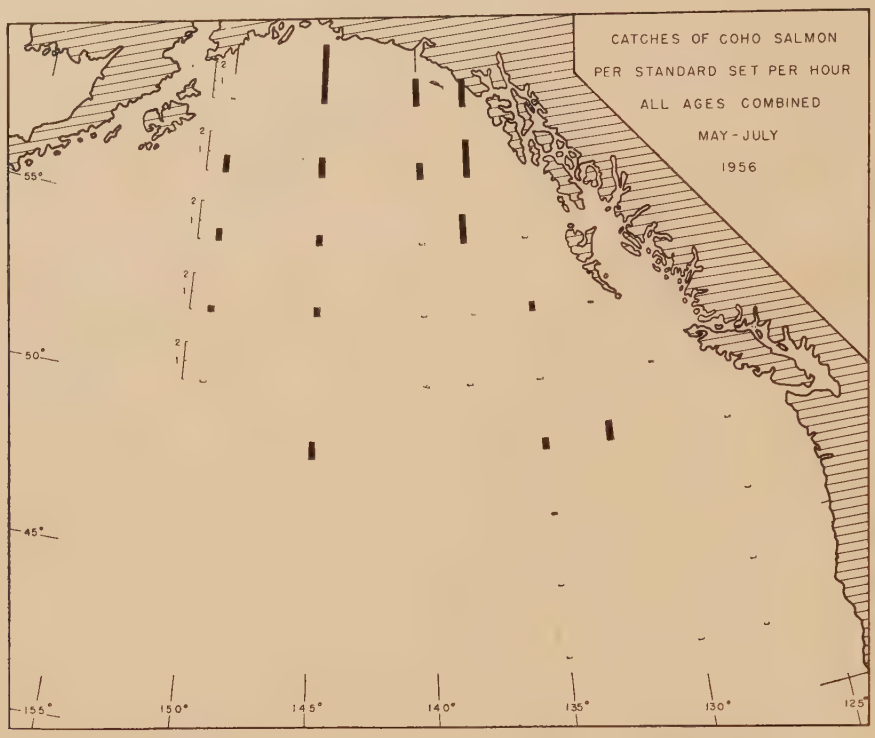

Fig. 5. Coho salmon catches during May - July, 1956.

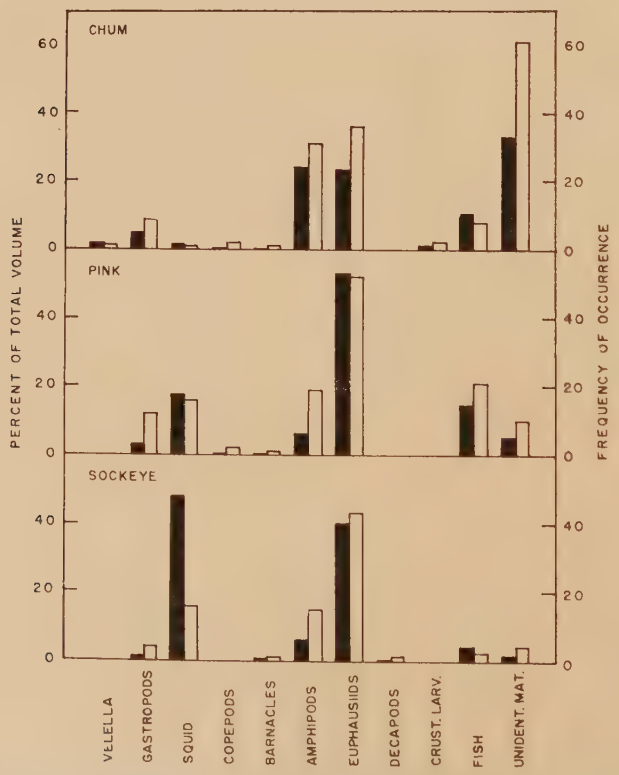

Fig. 6. Stomach contents of salmon. Solid bars: per cent. volume. Plain bars: frequency of occurrence.

The total number of shackles used for each set is given in Table 1. Nets were set out over a stern roller and were hauled in amidships by means of a power block.

Refrigeration equipment, consisting of a quick-freezing brine tank and cold storage boxes of 5,000-pound capacity, was installed on each vessel.

Salmon catches. The distribution of catches according to size of mesh is shown in Table 2. The 4½" mesh showed the greatest overall efficiency, but this was not true for each separate species.

Recorded data on the position of enmeshed fish in the nets showed that in sets made at night a majority of the salmon were caught in the upper half of the nets (total depth of nets was about 20 feet). In rough weather this preponderance was reduced and in the few sets made in the daytime more fish were caught in the lower portion of the nets.

Tables 3 to 7 give statistics of the sockeyes, pinks and chums constituting the catches.

toward fresh water. Furthermore, the southern limit of feeding fish appeared to shift nothward with the advance of the summer season—at least as regards the fish available to surface nets. Thus, while salmon were caught at Latitude 46° in June, they were only taken north of Latitude 50° in July and August (see Table 1).

Food. Stomachs have been examined of sockeye (190), pink (96) and chum (125). Of these, 24% of the sockeye stomachs, 56% of the pink stomachs and 55% of the chum stomachs contained food. The main categories of organisms in these stomachs are shown in Figure 6. While the three species of salmon show quantitative differences in the proportions of various organisms consumed, it is even more evident that there is much similarity in the diet.

Environmental conditions. In conjunction with fishing operations the following observations and samples were taken:

	Bathythermograph casts	Salinity samples	Total phosphate samples	Plankton samples	
				Vertical	Horizontal
Number of observations	202	582	202	195	44

Distribution of species. The wide general distribution of sockeye, pink, chum and coho salmon is shown in Figures 2 to 5. Certain changes in the distribution picture took place during the course of the summer. In July and August, mature fish became scarce in high-seas catches because of their migration

Factors influencing distribution. Table 8 shows that salmon were caught at surface temperatures ranging from 7°C. to 14°C. Average catches were reduced at temperatures above 12° and no salmon were caught when the temperature exceeded 14°. The findings were similar for all species.

TABLE 8. Catch of salmon in northeast Pacific, 1956, in relation to surface water temperatures.

		Sockeye		Pink		Chum		Coho		Spring	
Temp. °C.	No. of total sets	No. of sets with fish 1	Av. No. fish/ set/ hr. 2	No. of sets with fish 1	Av. No. fish/ set/ hr. 2	No. of sets with fish 1	Av. No. fish/ set/ hr. 2	No. of sets with fish 1	Av. No. fish/ set/ hr. 2	No. of sets with fish 1	Av. No. fish/ set/ hr. 2
7	1	1	0.86	1	0.29	1	0.29	1	0.86	1	0.57
8	1	1	0.73	—	—	—	—	—	—	—	—
9	4	4	0.62	2	0.41	4	1.17	4	0.29	—	0.04
10	3	2	0.70	3	1.86	1	0.23	2	0.66	—	—
11	8	6	1.04	7	1.00	6	1.77	8	0.88	1	0.02
12	13	7	0.78	10	0.87	8	1.16	4	0.52	2	0.01
13	7	1	0.17	1	0.07	1	0.23	1	0.04	—	—
14	8	—	—	3	0.48	2	0.43	1	0.13	—	—
15	1	—	—	—	—	—	—	—	—	—	—
16	1	—	—	—	—	—	—	—	—	—	—
17	—	—	—	—	—	—	—	—	—	—	—
18	1	—	—	—	—	—	—	—	—	—	—

Observed surface salinity values varied from 31.89 $^0/_{00}$ to 33.15 $^0/_{00}$. No correlation was found between catches and salinities within this range.

Miscellaneous catches. In addition to Pacific salmon, various other species of fishes, also squid, appeared from time to time in the nets (Table 9). It was of interest to find that the steelhead *(Salmo gairdneri)* was as widely distributed as the Pacific salmons in the region covered by Canadian fishing operations.

2. Distribution and Tagging of Juvenile Salmon.

In continuation of studies begun in 1955, the distribution and growth of young salmon during the early part of their marine life were investigated in the Chatham Sound - Dixon Entrance area of the British Columbia coast.

From early July to early September, fishing operations were carried out by the chartered drum-seiner *Cape Blanco*. In July, sampling of the young salmon populations was effected mainly by beach seining, but with the progressive movement of the fish away from the shorelines the purse-seine was used almost exclusively.

Figure 7 shows the areas and localities in which operations were conducted. The species composition of the catches was determined from samples which were preserved from each successful set. The remaining fish of the catches were tagged or, if too small

TABLE 9. Miscellaneous catches.

Species	Number of occurrences	Total number caught
Steelhead	16	34
Pomfret	16	504
Scad	10	112
Squid	10	54
Albacore	1	1
Rockfish	1	17
Dogfish	2	18
Blue Shark	14	55
Mackerel Shark	6	11

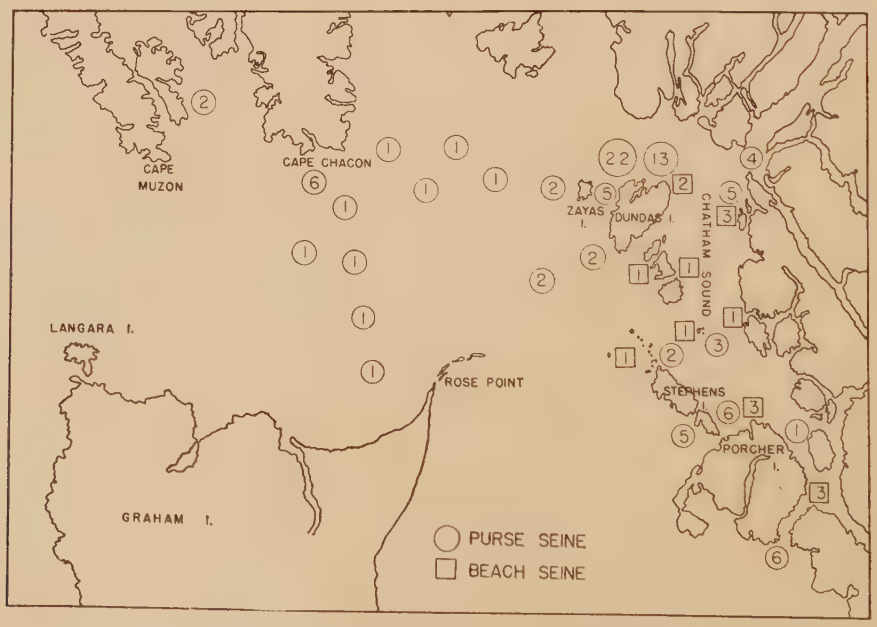

Fig. 7. Localities fished for juvenile salmon. Figures indicate number of sets made.

or otherwise unsuitable for this purpose, were released. Among approximately 10,000 juveniles which were either tagged or preserved, the species were represented in the following proportions: sockeye, 1.5%; pink, 87%; chum, 10%; coho, 1.5%.

The preserved samples were used to record changes in the length of pink and chum salmon captured during a two-month period beginning early in July (Figures 8, 9). Numbers of preserved sockeye and coho were insufficient to show progressive changes in size at short-time intervals. A total length range (fork length) from 7.5 cm. to 22.5 cm. was recorded for juvenile sockeye and from 8.2 cm. to 30.7 cm. for juvenile coho.

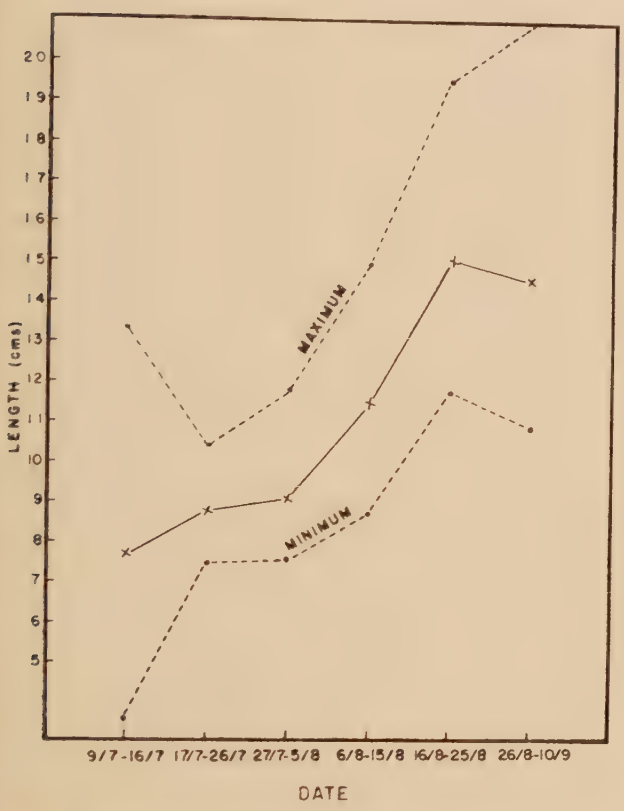

Fig. 8. Changes in size (fork length) of pink salmon, July 9 to September 10, 1956.

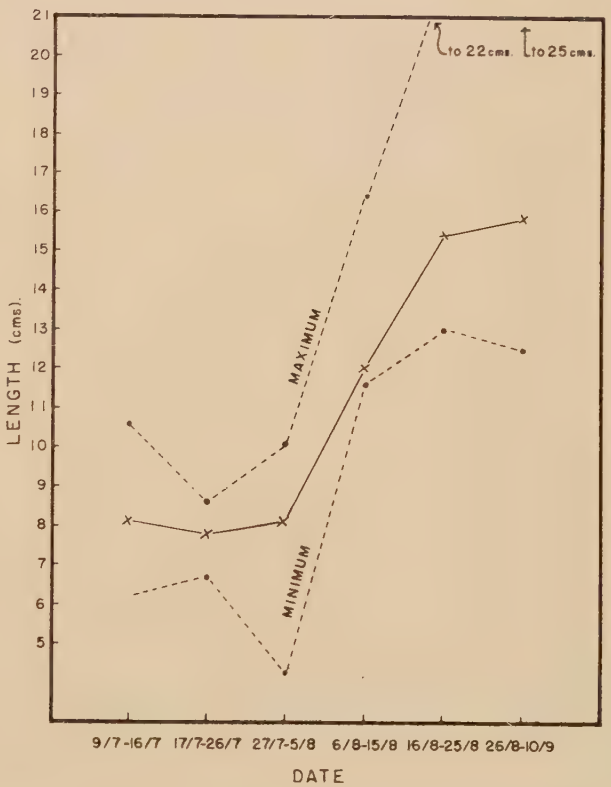

Fig. 9. Changes in size (fork length) of chum salmon, July 9 to September 10, 1956.

Tagging. A total of 7,717 juvenile salmon were tagged with "spaghetti" tags, the distribution being: sockeye, 9; pink, 6,629; chum, 900; coho, 179.

Five of these tags which had been applied at Dundas Island in late August and early September were recovered during the latter month, all being taken from the stomachs of large cohoes. In two instances the recoveries were made in Alaskan waters.

3. Skeletal Anatomy of Pacific Salmon.

This study was planned in two phases: (1) a description of the osteology of the principal species of Pacific salmon and of the changes which take place as maturity approaches, and (2) a search for differences in bone structure between stocks of the same species but of different river origin. The first phase is a prerequisite for the second as it is necessary to distinguish between the normal differences in bone structure associated with various stages of development and the differences which can be used to distinguish stocks.

In 1956 the first phase approached completion. The results consist of detailed descriptions which are difficult to summarize but which it is intended to publish as soon as possible.

Definite differences were found in the skeletal anatomy of the five principal species which can readily be distinguished by their osteology. Individuals of any one species pass through four stages differing in skeletal anatomy: (1) juvenile, (2) semi-adult and actively growing, (3) maturing, and (4) sexually mature. These stages can be identified by changes in the teeth and associated bones—premaxillary, maxillary, supralingual, vomer, palatine and pharyngeal. In young and semi-adult specimens the teeth are sharp and set more or less directly on the bones, and these **feeding teeth** may be replaced during active growth. In maturing individuals a new type of tooth appears, not attached to the bone but held firmly in the connective tissue. As the fish become mature these **breeding teeth** are set on large ossified bases which fuse to increase the size of the bones. The premaxillary bones are especially useful for indicating the onset of maturity.

A start was made in 1956 in the second phase of the study by examining certain head bones and caudal fin structures of sockeye, pink and chum salmon from a number of sample areas. As this report was written, adequate samples, especially from the western areas, were not yet available and it is not yet possible to present results on the recognition of stocks of various origins.

4. Use of Parasites to Distinguish Stocks.

The annual report for 1955 summarized results of the examination of part of the sockeye and pink salmon samples collected in 1955 and indicated that several parasites might be useful in distinguishing between Asiatic and North American stocks of salmon on the high seas. The present report summarizes results of examination of all 1955 samples and of a few collected in 1956. Many more sockeye samples and practically all the pink samples taken in 1956 have yet to be examined.

The total number of samples collected in 1956 is about three times the number examined in 1955. They comprise adult sockeyes and pinks from all major North American coastal areas and from high-seas stations spaced when possible at 5° intervals of longitude from North America to the Sea of Okhotsk and in the Bering Sea. Pinks from Hokkaido were also made available. Sockeye smolts from North America were again examined but pink fry were not studied because the 1955 results indicated that they are free or about free of parasites. The sample size of each species at each locality was usually 25 fish. United States and Japanese agencies have again co-operated in supplying the samples.

In 1955, 1,509 salmon were examined (966 sockeyes and 543 pinks). The sockeyes included 476 smolts, 92 marine juveniles and 398 adults. The smolts were taken from 13 localities from Alaska to the Columbia River. All marine juveniles were taken at one locality in British Columbia. The adult sockeyes were taken on the high seas (mainly in the western Pacific but also in eastern areas) and from 11 North American coastal regions, extending from Attu Island to Bristol Bay, Alaska and south to the Columbia River.

The pink salmon consisted of 100 fry, 74 juveniles and 349 adults. The fry were taken from two localities (one each in British Columbia and Alaska); the marine juveniles from two localities in British

Columbia. The adults were, with few exceptions, from essentially the same areas as the adult sockeye.

More than 50 species of parasites were encountered, some of which could not be identified because of the poor condition of the available specimens, but these were species of rare occurrence. Most of the parasites occurred in the alimentary tract, but some were taken from the muscle, body cavity, eyes, gills, skin and swim bladder. Forty-five species were identified, at least generically, of which two were monogenetic trematodes, 14 were digenetic trematodes, 9 were cestodes, 6 were acanthocephalans, 9 were nematodes, 4 were copepods, and 1 was protozoan. Only a few of the parasites offer promise in distinguishing between stocks of salmon of North American and Asiatic origin. A few others may be useful in distinguishing local stocks or identifying the origin of individual fish.

Sockeye Salmon. Forty-two identified species were found parasitic in sockeyes, of which 16 were acquired in fresh water and 24 in the sea. The origin of 2 species found in salmon taken in the sea is unknown. Of the known freshwater species, 4 were found to persist throughout the life of the fish. A fifth species found in adults seems to be of freshwater origin but it was not found in any of the smolts examined.

Parasites of freshwater origin retained throughout the life of the salmon would be ideal for distinguishing stocks of various origins if their distribution were restricted. Three of the four parasites with a life cycle of this type (*Diplostomulum,* a larval trematode; *Diphyllobothrium,* a larval cestode, and *Philonema,* a nematode) are more or less widely distributed and hence cannot be used to distinguish eastern from western stocks generally. However, since their distribution and abundance is not uniform throughout all salmon populations, they may be used to separate local populations. The fourth species, *Triaenophorus crassus,* is a larval cestode found in the musculature and has a very limited distribution. The adult stage of this parasite is found only in the pike (*Esox lucius*) and the presence of *Triaenophorus* in sockeye is dependent on the coexistence of young sockeye and pike in the same watershed. As far as is known, particularly in North America, pike are absent from most sockeye spawning areas. *Triaenophorus* was found in smolts and adults of only two localities, both in the Bristol Bay area. In Lake Aleknagik (or Wood River) 36% and 52% of the 1955 and 1956 smolt samples, respectively, carried *Triaenophorus.* Thirty-six per cent. of the adult sample from this locality in 1956 were infected with *Triaenophorus.* Smolts and adults from the Naknek River showed an incidence of 16% and 4%, respectively, with *Triaenophorus.* Two sockeye, with *Triaenophorus,* were taken on the high seas in 1956, and our present knowledge suggests that these were of Bristol Bay origin. One of the two was taken at 56°N., 150°W. (Gulf of Alaska) and the other was taken at 51°N., 175°E.

The 1955 samples indicated that of the 24 marine-acquired parasites, 4 showed differences in occurrence between eastern and western samples, and might be useful in distinguishing between stocks of eastern and western origins. However, because all of the western samples were from the high seas and most of the eastern samples were from coastal areas, the possibility was entertained that the differences observed in the distribution of one of the parasites was actually due to onshore-offshore differences rather than true east-west differences. The information gathered from the 1956 samples studied so far seems to support this view. The four parasites will be discussed individually.

(1) *Hemiurus levinseni* (Fig. 10). This stomach trematode was present in 21% to 56% of the 5 samples taken in 1955 from Attu Island to the Sea of Okhotsk, with an average of 2 to 4 per infected fish. Of the 12 areas sampled in 1955 from the Alaska Peninsula to the Columbia River, the parasite was found but once in each of 3 localities. Of the 1956 samples, the parasite was encountered in 4% to 8% of the fish from 3 of 17 localities east of 175°E. longitude. These comprised nine coastal areas (one with 2 infected sockeye) and 8 high-seas stations, including one in the Bering Sea. The parasite thus has a much greater abundance in sockeye from western waters. The distribution of *H. levinseni* in the 1955 samples is shown graphically in Fig. 10. In this and other figures the incidence of occurrence (i.e., the percentage of the sample infected, irrespective of the number of parasites per infected fish) is plotted by area.

(2) *Tubulovesicula lindbergi* (Fig. 10). In 1955 this stomach trematode was present in small numbers

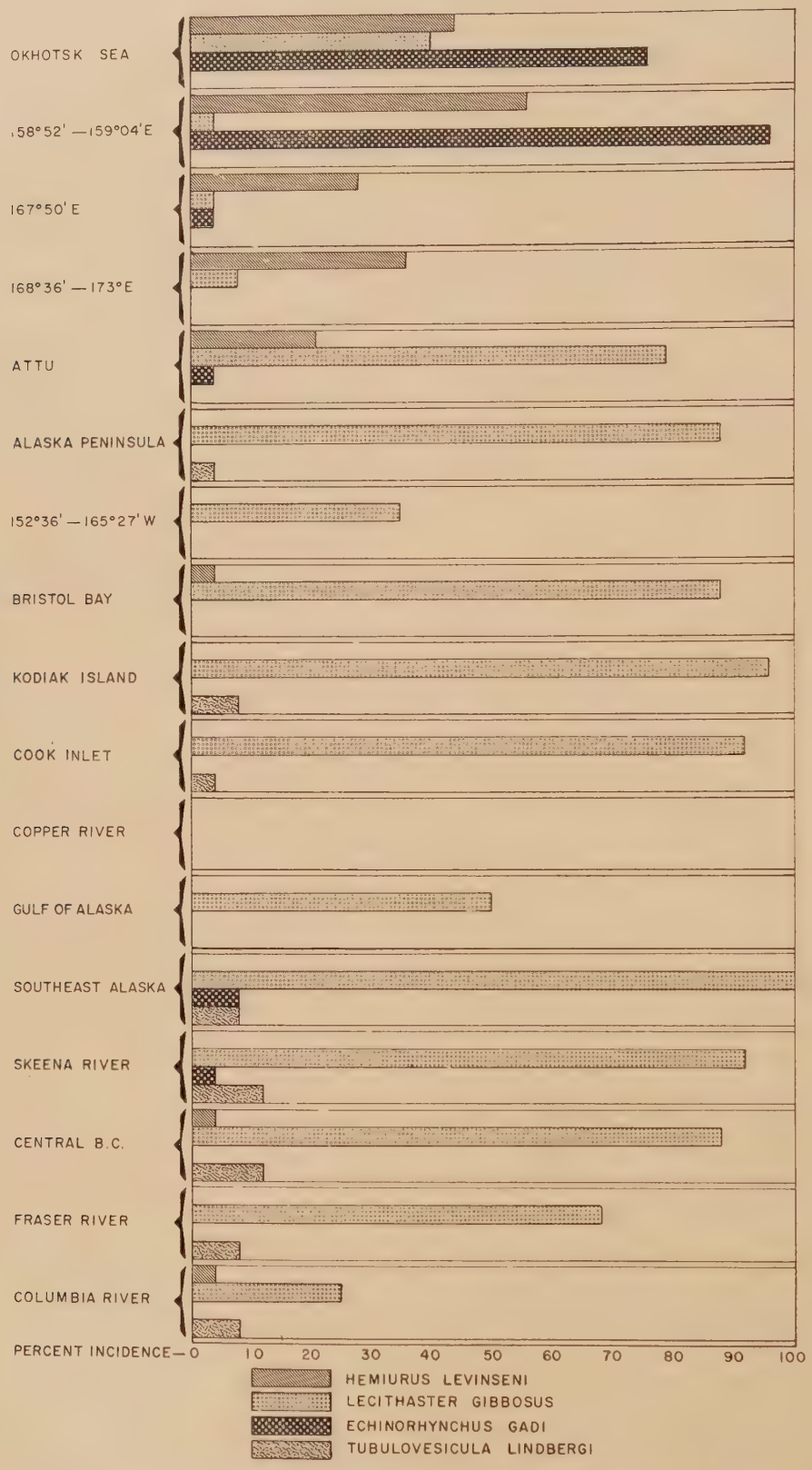

Fig. 10. Per cent. incidence of certain parasites of sockeye salmon in different areas (1955 samples).

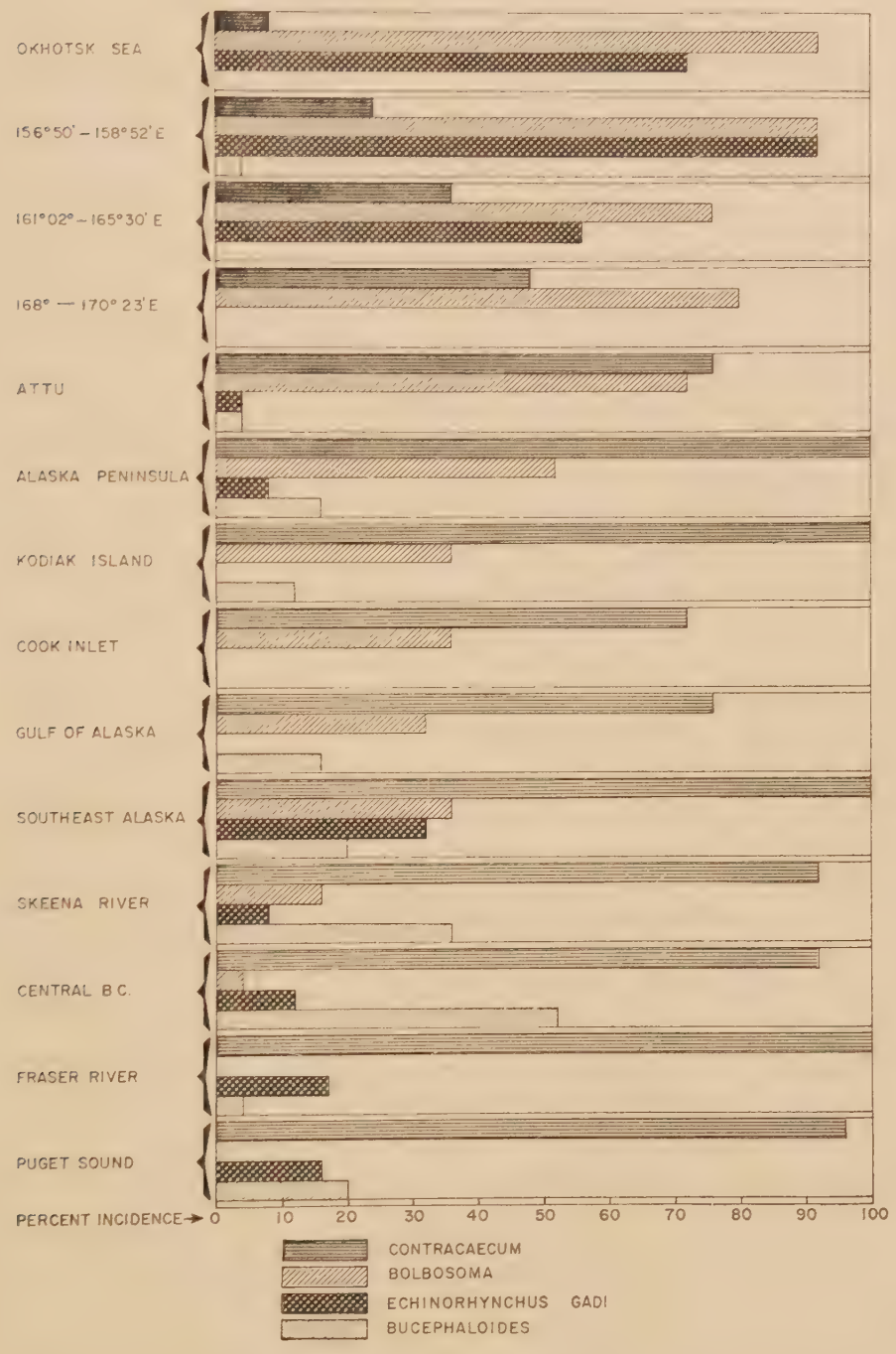

Fig. 11. Per cent. incidence of *Contracaecum*, *Bolbosoma*, *Echinorhynchus* and *Bucephaloides* in pink salmon in different areas (1955 samples).

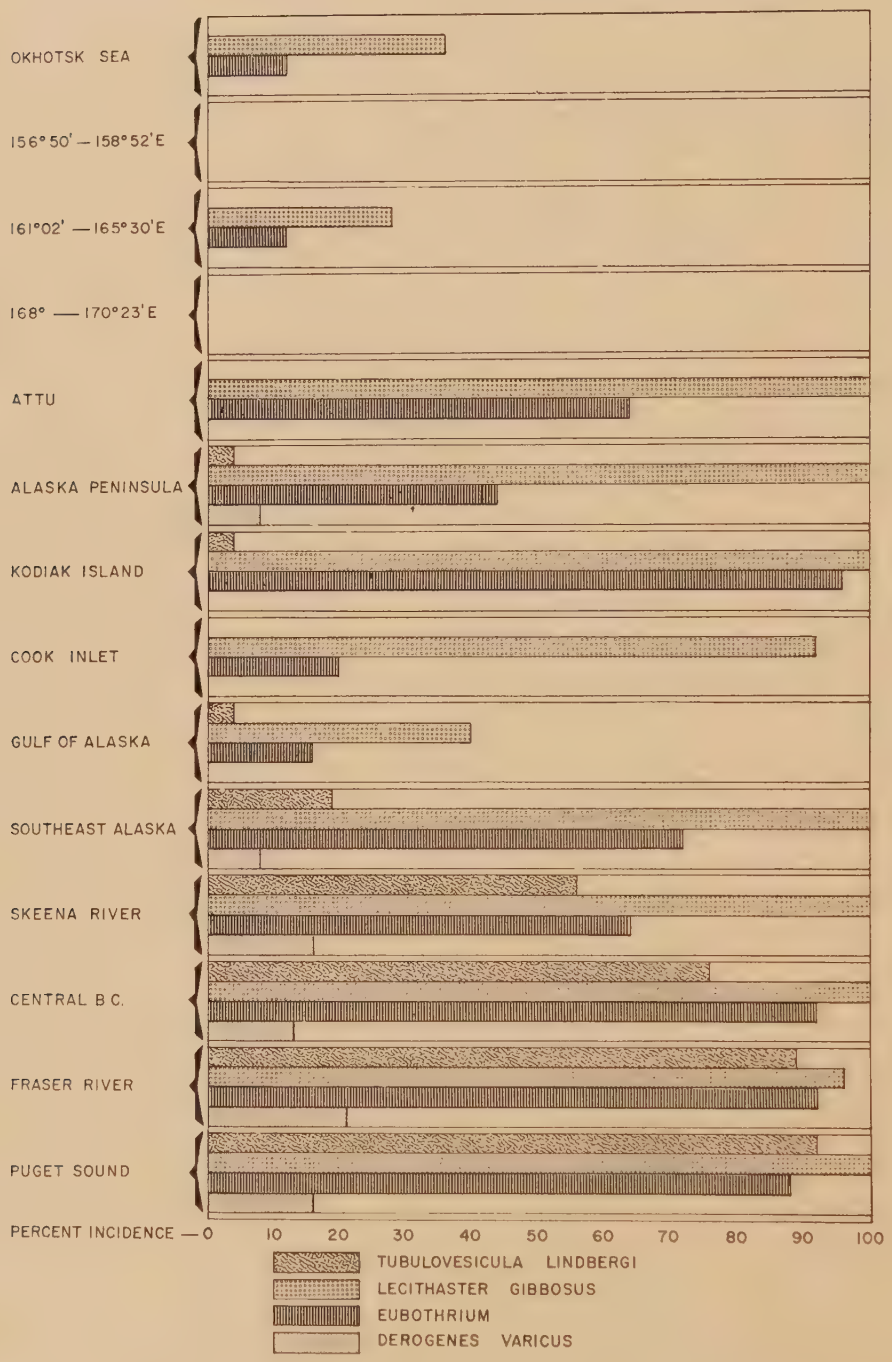

Fig. 12. Per cent. incidence of *Tubulovesicula*, *Lecithaster*, *Eubothrium* and *Derogenes* in pink salmon in different areas (1955 samples).

in 8 of 12 samples from eastern waters and entirely absent from 5 samples from Attu to the Sea of Okhotsk. In 1956 it was again found, sometimes in greater numbers than in 1955, in 10 of 17 localities from 175°E. longitude to the North American coast. The literature on fish parasites in Pacific Asiatic waters does not indicate that this parasite has been found in salmon. The presence of this parasite seems to indicate sockeye of eastern origin.

(3) *Echinorhynchus gadi* (Fig. 10). In 1955 this acanthocephalan was very common in the Sea of Okhotsk and the most westerly (159°E.) of the Pacific high-seas samples. Between 161° - 165°E. and at Attu it was observed but once. East of Attu the parasite was absent from 10 of 12 areas and was rarely encountered in the adjacent areas of southeastern Alaska and the Skeena River, British Columbia. The parasite was absent from all sockeye studied in 1956 from 17 localities east of 175°E. longitude. The value of this parasite in distinguishing between eastern and western sockeye stocks is not clear, but it was extremely characteristic of far-western samples.

(4) *Lecithaster gibbosus.* This intestinal trematode (Fig. 10) is mentioned here since in the 1955 report it was selected as having possible significance. In the coastal samples from North America in 1956 the parasite was again found to be very common, but in the high-seas samples from 175°E. to 140°W. longitude the incidence and intensity of occurrence approaches that of the western high-seas samples in 1955. It is suggested that differences in occurrence are onshore-offshore rather than east-west. Examination of the remainder of the 1956 samples should clarify the picture.

Pink salmon. Twenty-seven species of parasites were recovered from pinks, of which 25 were of marine origin, 1 is possibly of freshwater origin, and 1 unknown. Eight of the marine-acquired parasites show, to a greater or lesser degree, substantial differences in incidence between eastern and western stocks and may prove useful in distinguishing these stocks.

(1) *Bolbosoma* sp. (Fig. 11). This post-larval acanthocephalan is found in the intestines. In the 1955 samples it was present in 72% to 92% of the 5 samples from Attu to the Sea of Okhotsk, with an average of 5 to 21 per infected fish. From the Alaska Peninsula eastward and southward the incidence decreased progressivly from 52% to complete absence at the Fraser River and Puget Sound, Washington. The average number of parasites per infected fish in the eastern areas was from 1 to 3. Abundance of *Bolbosoma* thus seems to be characteristic of western stocks.

(2) *Contracaecum* (Fig. 11). The distribution of infection with *Contracaecum* was the reverse of that of *Bolbosoma.* In all areas from Attu to the east the incidence of *Contracaecum* was between 72% and 100%. West of Attu the incidence decreased progressively from 48% to 8% in the Sea of Okhotsk. Abundance of *Contracaecum* was associated with eastern stocks.

(3) *Echinorhynchus gadi* (Fig. 11). A high abundance of this parasite in the three most westerly areas was evident in 1955. It occurred in 56% to 92% of the samples, with an average intensity of 3 to 5 per fish in the infected groups. From Attu east, the parasite was present in 3 of 10 areas but the incidence was less than 20%, except in southeast Alaska where it was 32%. The average intensity in the eastern areas was 1 to 3 per fish in the infected groups. The absence of *Echinorhynchus* from the sample taken between 168°E. and 170°E. is not promising for the use of this parasite as a means of distinguishing eastern and western stocks of pinks. However, the high incidence in the three most westerly areas seems to be of significance.

(4) *Bucephaloides* sp. (Fig. 11). This intestinal trematode appears essentially to be a parasite of eastern stocks of pinks. It was found in only 2 fish of the 5 samples from Attu to the Sea of Okhotsk. Of the 9 samples from the Alaska Peninsula eastward, 8 areas, including the offshore area of the Gulf of Alaska, yielded *Bucephaloides.* In 7 of the areas it was present in more than 10% of the sample (12% to 52%), but in the Fraser River sample it occurred only in 4%.

(5) *Tubulovesicula lindbergi* (Fig. 12). As in sockeye, this trematode also appears to be characteristic of eastern stocks. It was not found in the samples from Attu to the Sea of Okhotsk, but was recovered from 8 of the 9 areas, including the offshore sample in the Gulf of Alaska, in from 4 to 92% of the sample.

There was a progressive increase eastward and south from the Alaska Peninsula.

(6) *Lecithaster gibbosus* (Fig. 12). The incidence and intensity of infection in pinks from North American coastal areas was immensely greater than that in western high-seas areas. However, the Gulf of Alaska sample of pinks showed an infection rate similar to that of western high-seas areas. The apparent east-west differences are probably in reality a reflection of onshore-offshore differences, as noted in sockeyes.

(7) *Derogenes varicus* (Fig. 12). This stomach trematode was absent from the 5 samples from Attu westward and was found in 6 of the 9 eastern samples. The incidence varied from 8% to 21%. Since the parasite was absent from the one offshore area from which pinks were available, *Derogenes* may also be reflecting onshore-offshore rather than an east-west difference.

(8) *Eubothrium* sp. (Fig. 12). This cestode was very abundant in eastern coastal areas and found only in small numbers in 2 of the 4 areas west of Attu. However, the Gulf of Alaska offshore sample displayed an abundance of *Eubothrium* only slightly higher than that in the two western areas. Again *Eubothrium* may be reflecting offshore-onshore differences rather than east-west differences.

Summary. The differences in parasitism between eastern and western samples of pinks and sockeyes indicate that the study of parasites has promise as a means of distinguishing salmon stocks of North American and Asiatic origin. Of the parasites that were selected as possibly possessing value in distinction of stocks from the two continents, some indicated that Attu salmon are similar to samples to the west, whereas others indicated that Attu fish were similar to eastern samples. Completion of examinations of the 1956 collection of sockeyes and pinks should shed more light on the problem.

In the coastal areas of North America, several species of parasites increase or decrease in abundance from north to south. In both pinks and sockeyes, *Brachyphallus crenatus* (Trematoda), *Phyllobothrium caudatum* (Cestoda) and *Bolbosoma* sp. (Acanthocephala) tend to decrease in abundance from Alaska to the Columbia River or Puget Sound. On the other hand, in pinks, *Hemiurus levinseni, Tubulovesicula lindbergi* and *Eubothrium* sp. increase in abundance from north to south.

There is also evidence that some parasites are more prevalent in coastal areas. *Brachyphallus crenatus* and *Lecithaster gibbosus* in pinks and sockeyes appeared in greater numbers in coastal samples. Information to be obtained from 1956 samples may indicate other parasites that should be included in this category.

There are many differences between parasitism in sockeyes and pinks. Even the distribution and abundance of the same species of parasite may differ greatly between the two species of salmon. *Hemiurus levinseni,* for example, seems to indicate sockeyes of western origin, but in pinks it is common on both sides of the ocean. Some of the parasite differences are attributable to the longer fresh-water period of residence of sockeye before migrating to sea whereas others seem to reflect differences in feeding habits at sea.

There are some parasites of marine origin that are very restricted in distribution and may be useful in identifying the origin of fish on the high seas. The trematode *Podocotyle shawi* was found only in sockeyes from the Columbia River and the cestode *Diplocotyle* sp. was found in pinks and sockeyes only at Attu. If fish on the high seas are found to be infected with either of these parasites, their origin could be stated with considerable certainty.

A detailed report of the results and interpretations thereof obtained from samples collected in 1955 was distributed at the Commission's meetings in Seattle in November, 1955.

5. Use of Salmon Scales to Distinguish Stocks.

Canadian work in this field is at too early a stage to report results. Scale samples are being collected and exchanged with United States and Japanese agencies in order to compare and improve interpretations. It is intended to continue and intensify studies in this field in close co-operation with those of the other two member nations.

6. Oceanography.

Canadian oceanographic explorations in the northeast Pacific have provided five bodies of data.

(1) During the summer of 1936 the area 100 miles seaward of Vancouver Island was surveyed and studied. (2) A series of surveys of the Canadian offshore waters (east of longitude 141°W.) was made in winter, spring, and summer in 1950-51-52. (3) The co-operative project NORPAC covered the whole ocean north of latitude 22°N. during August, 1955. In this, the Canadian contribution was the part from latitude 47°N. to 55°N. and westward to longitude 180°. (4) During August, 1956, a survey was carried out covering the Gulf of Alaska and the adjacent ocean southward to latitude 40°N. and westward to longitude 175°W. This was the most extensive and comprehensive of the Canadian surveys. It included observations of temperature, salinity, total and inorganic phosphates, nitrates, silicates, alkalinity and hydrogen ion (pH) at all depths to 1,500 meters. (5) Daily observations of sea-water temperature from the surface to 150 metres depth have been taken at Ocean Weather Station PAPA (latitude 50°N., longitude 145°W.) since 1950. This program was expanded in August, 1956, to include salinity, the dissolved nutrient and respiratory constituents, and plankton.

Some results of preliminary analyses of recent data and comparisons with earlier data are summarized below.

Temperature. Both in August, 1955 (See INPFC Annual Report for 1955) and in August, 1956 (Fig. 13), the warmest waters appeared in mid-ocean south of latitude 40°N. From there to latitude 50°N. the temperatures decreased in a well-marked gradient to a region of minimum temperature, extending from the Aleutian Islands across the Gulf of Alaska. From this minimum, the temperatures increased shoreward all around the Gulf. In August, 1955, the isotherms extended almost east and west in mid-ocean. Closer to North America those isotherms south of latitude 47°N. veered southward, providing a marked temperature gradient toward the United States coast. Those isotherms north of latitude 47°N. veered northward and around the Gulf of Alaska. In August, 1956, the waters east of longitude 150°W. were warmer by one to two degrees than in the previous year, as indicated by the more northward slant of the isotherms.

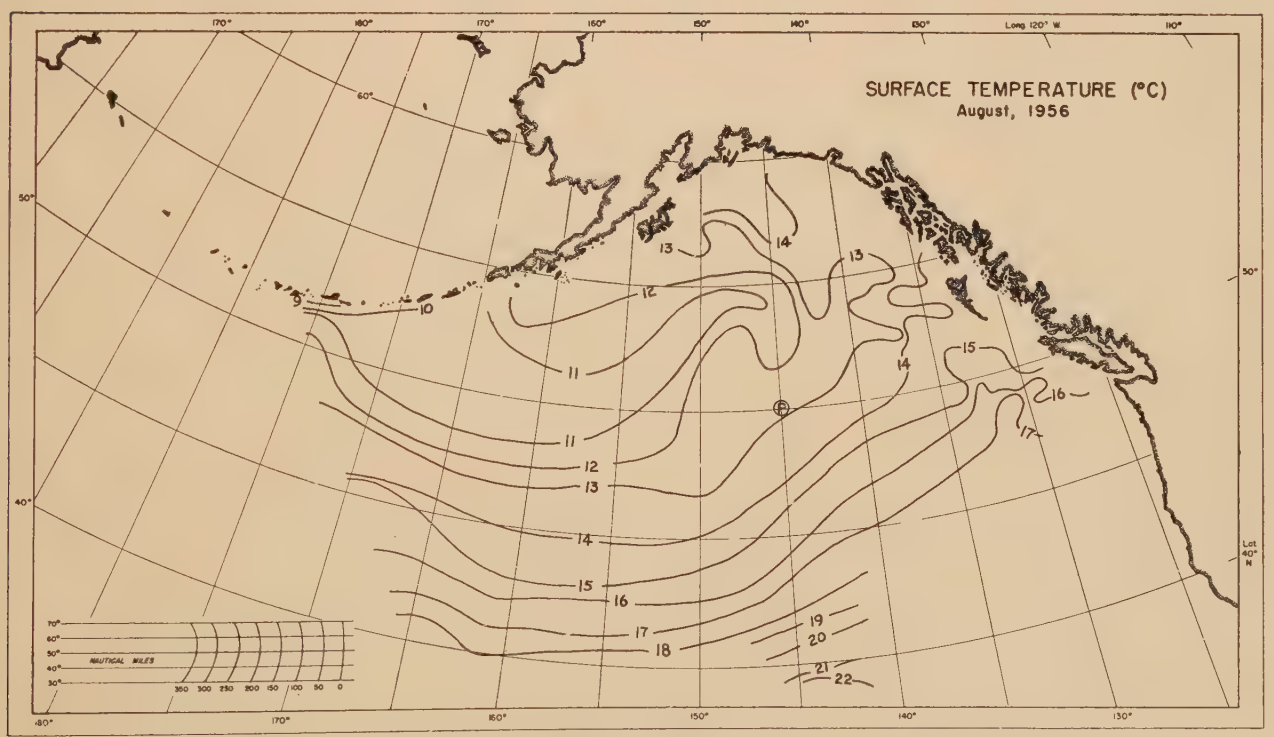

Fig. 13. Surface water temperatures (°C) in the northeast Pacific, August, 1956.

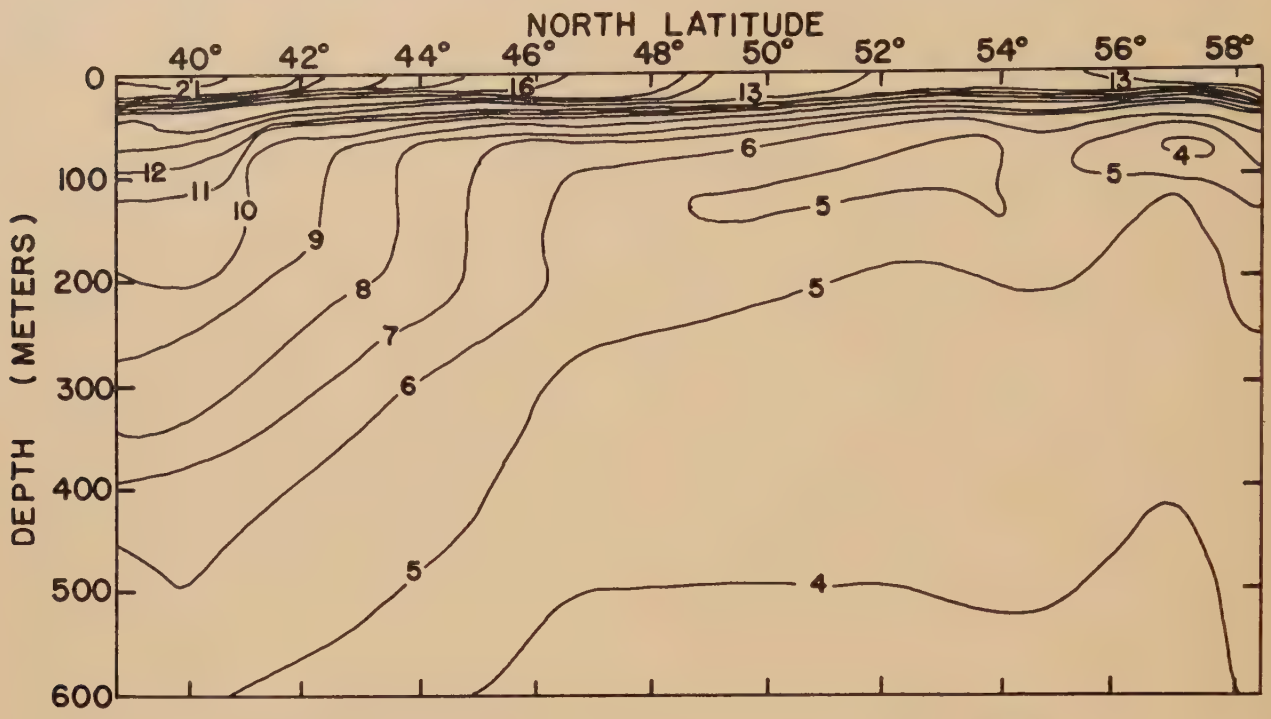

Fig. 14. Temperature (°C) structure along latitude 142°W., August, 1956.

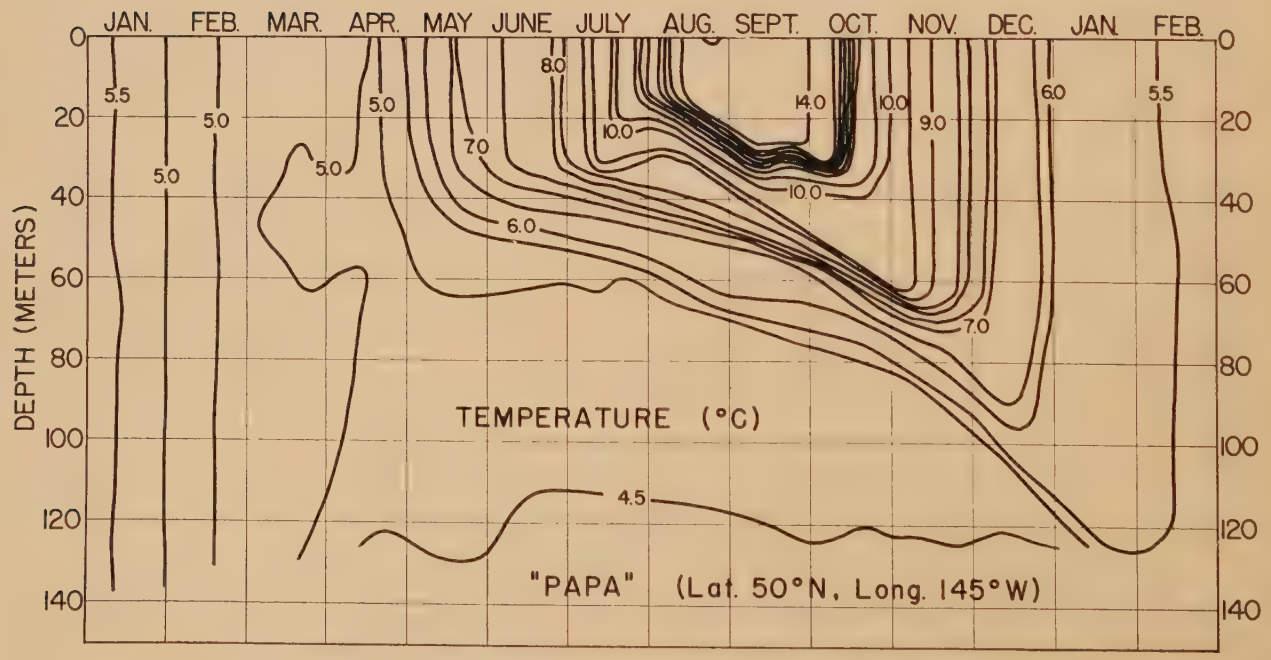
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC. JAN. FEB.
DEPTH (METERS)
0 20 40 60 80 100 120 140
5.5 5.0 5.0 5.0 5.0 7.0 8.0 10.0 14.0 10.0 9.0 6.0 5.5 10.0 6.0 7.0
TEMPERATURE (°C)
4.5
"PAPA" (Lat. 50°N, Long. 145°W)

Fig. 15. Sea water temperatures (°C), Station Papa, 1954-55.

The north-south sections (Fig. 14) show that there was a warm surface layer, separated from the deep cold waters by a marked thermocline between 25 and 50 metres depth. In the deep water, below 50 metres depth, the temperature decreased generally towards the north, and with depth. In both years there was evidence of temperature inversions at about 100 metres depth, but these were most apparent in 1956.

These diagrams were compared with mean August surface temperatures from pilot charts and other sources. The major features shown here are representative but the surface waters were slightly colder than average in 1955, and somewhat warmer than average in 1956.

A typical annual cycle of temperature at Ocean Weather Station PAPA (latitude 50°N., longitude 145°W.) is illustrated in Figure 15. In the winter the waters in the upper 100 metres of depth are isothermal. Vernal heating starts in April and continues until the end of September. During this time an upper zone of warmed water is created whose depth increases from 50 to 85 metres. The autumn cooling creates an isothermal layer which cools and deepens from late September to January. This cycle of heating and cooling in the upper 150 metres is apparent at least as far south as latitude 35°. Recent studies, however, indicate that south of latitude 40°N. the surface waters are always warmer than the deep waters. Northward from latitude 47° (surface isotherm 13° C. in Fig. 13) the surface waters become colder than the deep waters in February. Between these is a transition region where the extreme effect of winter cooling makes the water isothermal.

Below 150 metres existing evidence indicates that the temperature structure is nearly constant throughout the year and the small variations non-seasonal.

Salinity. The surface salinity in both years (Figures 16 and 17) was lowest along the North American coast, and increased towards mid-ocean and the Tropics. The surface gradient was most marked in mid-ocean between latitudes 40°N. and 47°N. and in the immediate vicinity of the coast. In the central part of the Gulf of Alaska, the surface salinity varied only slightly with a secondary maximum ($32.8\,^{0}/_{00}$) in the middle. Comparison of the

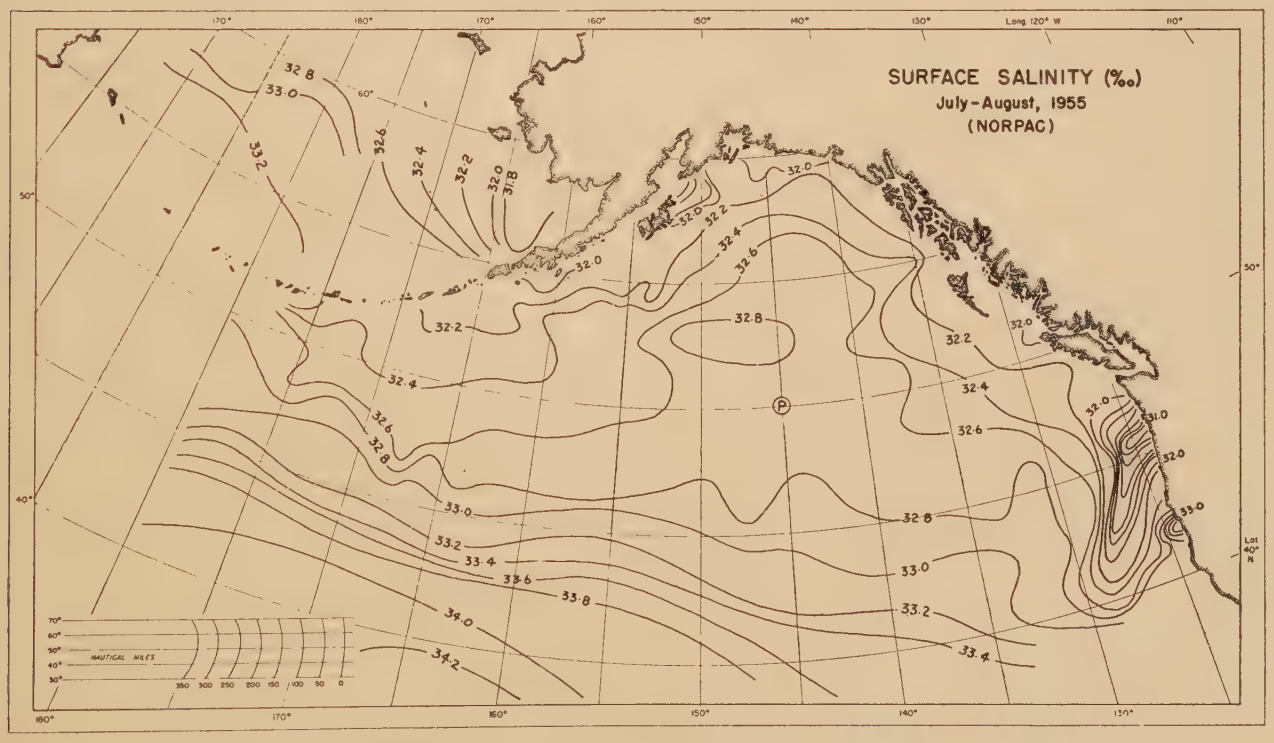

Fig. 16. Surface salinities($^{0}/_{00}$) in the northeast Pacific, July - August, 1955.

two surface charts shows that the general features of salinity distribution were similar in the two years except that the secondary maximum was farther north and more extensive in 1956.

In the Commission's Annual Report for 1955 (Fig. 3, p. 35) it was pointed out that there is an upper zone of low salinity water (generally less than 33.2 $^0/_{00}$) in the area north of the surface salinity gradient noted above. This was observed again in August 1956. A review of the more limited earlier data indicates that it is a permanent year-round feature distinguishing these from the more southern waters in which salinity is greatest at the surface.

"Sub-Tropic" and "Sub-Arctic" regions. Thus, in the upper 200 metres of depth in the North Pacific there are two distinct regions which may be designated as sub-tropic and sub-Arctic. The sub-Tropic is the region where the summer surface temperatures are greater than 21° C. and the surface salinity is greater than 34.2 $^0/_{00}$. Here the upper waters are always warmer than the deep waters, and the salinity decreases with depth. The sub-Arctic is the region where the summer surface temperatures are less than 20° C. and the surface salinity is less than 33.8 $^0/_{00}$. Here the upper waters become as cold as, or colder than, the deep water during the winter, the salinity increases with depth, and there is a well-defined upper zone of low-salinity water overlying the deep water.

Salmon fishing in the eastern Pacific shows that salmon occur in all coastal waters from California northward around the Gulf of Alaska, along the Aleutian Islands, and in the Bering Sea. Recent fishing for salmon and tuna on the high seas has found salmon generally scattered in the sub-Arctic waters as far south as latitude 42°N., but not in the sub-Tropic waters.

Circulation. In August, 1955, a broad slow movement (1 to 2 miles a day) entered the area from the west and progressed eastward toward the North American coast. This may be generally identified as the West Wind Drift, grading from Oyashio water along the northern side (latitude 50°N.) to Kuroshio water along the southern side (latitude 30°N.). Between longitudes 150°W. and 140°W. the waters north of latitude 47°N. veered northward

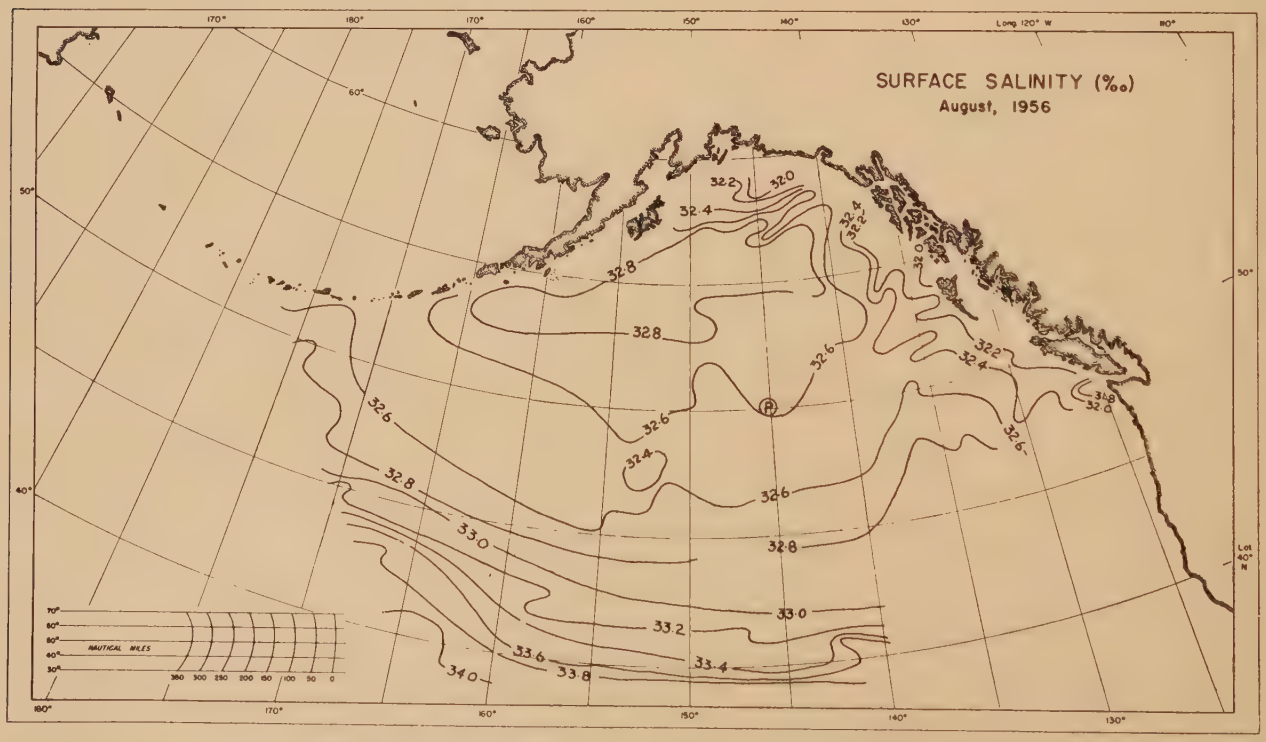

Fig. 17. Surface salinities($^0/_{00}$) in the northeast Pacific, August, 1956.

and circulated around the Gulf of Alaska in an anti-clockwise direction. These waters were apparently dissipated, to some degree, through the Aleutian Islands into the Bering Sea. A similar circulation was observed in August, 1956.

The rate of this circulation, as calculated from the observations in August, 1955 and 1956, was too slow to accord with other evidence, and it is suggested that the circulation is more rapid in winter. Further information will be available from returns of drift bottles released in August 1956 and at regular intervals from ocean weathership PAPA (50°N., 145°W.) and from the results of oceanographic surveys of this area in winter.

Plankton. Collections of plankton were made in association with the sampling of salmon on the high seas (see Section 1 above). Vertical hauls from 150 metres were made at the start and completion of each gill-net set and every six hours while running between stations. The gear used (45 cm. diameter net of 0.33 mm. mesh opening) was that recommended as a standard by the February 1956 conference on NORPAC results at Honolulu. Surface horizontal tows with the same net were also made at each fishing station for comparison with salmon stomach contents.

The wet weight of the plankton in each sample (including the separate wet weight of each group of organisms constituting more than 1% of the total) will be made available shortly in a data report with associated physical and chemical oceanographic data.

Crustacea usually amounted to 90% or more of the total sample; phyto-plankton, tunicates and medusae and, to a lesser extent, gastropods and squids, constituted most of the remainder. The survey area was covered three times (May-June, July and August) and great seasonal changes in the abundance and distribution of the plankton overshadowed geographical differences. In general the crustacean plankton increased from June to July and decreased again in August, although exceptionally rich samples were found about 155°W. longitude and 50°N. latitude. There are also some major geographical differences both in quantity and nature of the plankton (for example, the samples south of 43°N. were distinguished by the presence of goose-barnacle larvae *(Lepas)* but it is too early to generalize regarding the pattern of plankton distribution in relation to the physico-chemical oceanography or the salmon.

C. INTERIM REPORT ON SALMON INVESTIGATIONS IN THE NORTH PACIFIC IN 1956

by the Fisheries Agency of the Japanese Government

FOREWORD

This interim report presents the results of compilations and studies up to the present time based on data obtained from the commercial catches and other materials collected by the salmon-fishing motherships, which operated in the North Pacific and its adjacent areas from early May to early August, 1956, and also on data collected by three government research vessels, *Etsuzan Maru, Takuyo Maru* and *Eiko Maru,* which conducted investigations during the same period.

At the present time, most of the collected materials are still under study and their analysis is far from being complete. However, studies on some problems appear to offer promise.

Progress is reported in the order established in the overall program of research adopted by the International North Pacific Fisheries Commission at its 1954 Annual Meeting.

1. OFFSHORE DISTRIBUTION OF SALMON.

A. Collection and Analysis of Records of Commercial Catches.

The compilation and analysis of the data on the mothership fishery in the Aleutian areas has not been completed. The salmon catches in these waters are summarized in Tables 1 and 2 and Figure 1.

B. Special Fishing by Research Vessels for Collection of Scientific Data.

The following three vessels were chartered as Government research vessels:

Takuyo Maru
steel vessel — 171 gross tons — 330 h.p.

Etsuzan Maru
steel vessel — 153 gross tons — 330 h.p.

Eiko Maru
steel vessel — 117 gross tons — 320 h.p.

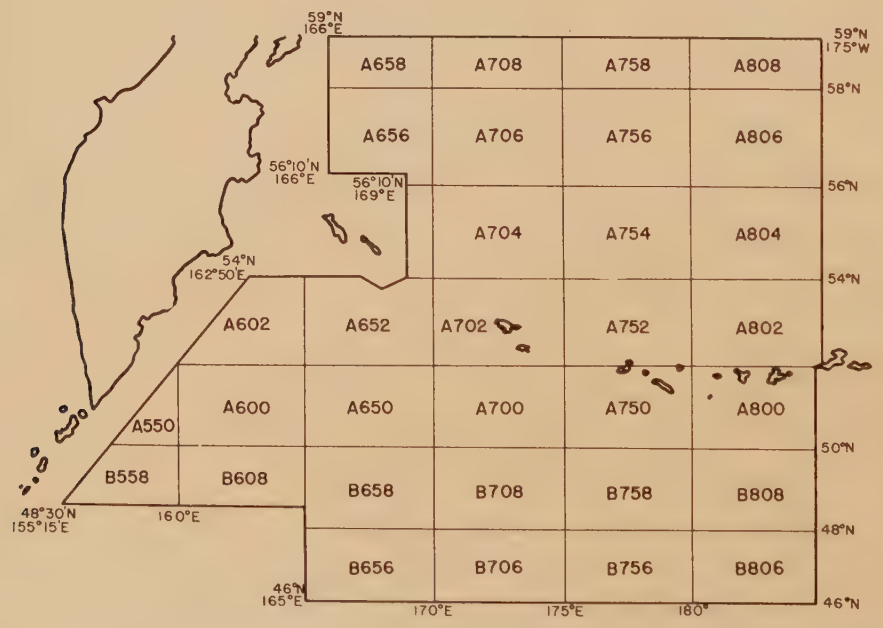

Fig. 1. Chart showing statistical areas for the Japanese mothership fishery in Aleutian waters, 1956.

TABLE 1. Catch of the mothership salmon fishery in Aleutian waters, by species and by week in numbers of fish and in pounds of round weights, 1956.

Week Ending	Sockeye		Chum		Pink		Coho		Chinook		Totals	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
May 5	44,571	137,284	112,490	333,088	22	64	19	88	35	780	157,137	471,304
12	631,910	2,703,928	1,575,762	6,592,239	216	597	—	—	527	6,475	2,208,415	9,303,239
19	430,978	1,864,905	1,270,991	5,349,140	79	209	1	4	461	6,215	1,702,510	7,220,473
26	413,342	1,748,307	840,838	3,310,054	5,875	16,239	1	9	523	6,087	1,260,579	5,080,696
June 2	724,962	2,992,050	1,862,066	7,541,112	80,859	228,774	11	46	941	9,079	2,668,839	10,771,061
9	613,759	2,807,752	1,258,033	5,326,104	156,480	403,016	64	293	1,090	10,227	2,029,426	8,547,392
16	567,045	2,827,177	1,691,207	7,005,426	111,310	300,545	45	218	3,031	27,569	2,372,638	10,160,935
23	1,108,408	4,974,951	2,184,419	9,034,509	95,334	272,551	315	1,325	4,666	36,934	3,393,142	14,320,270
30	1,120,772	5,040,193	811,347	3,290,208	18,236	57,036	2,969	13,576	31,445	169,399	1,984,769	8,570,412
July 7	935,542	3,588,833	676,436	2,663,215	66,277	213,392	232,735	906,586	17,065	83,218	1,928,055	7,455,244
14	99,310	707,008	1,032,288	4,041,493	443,368	1,420,065	1,462,238	7,115,811	23,143	149,121	3,060,347	13,433,498
21	452,769	1,981,849	977,614	4,198,910	4,407,572	13,369,632	464,785	2,466,999	9,583	73,502	6,312,323	22,090,892
28	991,107	3,983,928	1,330,788	5,661,663	4,008,155	12,169,582	609,199	3,232,773	15,483	112,974	6,954,732	25,160,920
Aug. 4	767,908	2,968,110	773,537	3,400,139	1,904,040	6,018,856	608,440	3,330,228	16,070	114,656	4,069,995	15,831,989
11	731,163	2,703,652	769,100	3,468,630	708,755	2,448,264	376,634	2,237,484	12,457	89,433	2,598,109	10,947,463
Total	9,633,546	41,029,927	17,166,916	71,215,930	12,006,578	36,918,822	3,757,456	19,305,440	136,520	895,669	42,701,016	169,365,788

TABLE 2. Catch of the mothership salmon fishery in Aleutian waters by month and by area, in numbers of fish, with numbers of tans of net used, 1956.†

Areas	Sockeye	Chum	Pink	Coho	Chinook	Total	Nets used in tan
May Total	**1,826,584**	**4,484,576**	**50,589**	**7**	**1,807**	**6,363,563**	**1,836,744**
B 656	392,497	727,382	25,853	1	495	1,146,228	343,685
B 658	52,399	95,586	3		53	148,041	40,417
A 700	438,052	1,187,545	1,295	1	293	1,627,186	432,832
A 702	107	797				904	150
B 706	17,097	31,389	2		8	48,496	18,090
B 708	405,272	1,377,026	1,348	2	513	1,784,161	507,737
A 750	276,763	474,595	9,482	2	202	761,044	232,284
B 758	244,397	590,256	12,606	1	243	847,503	261,549
June Total	**3,480,532**	**6,193,284**	**382,749**	**3,370**	**39,333**	**10,099,268**	**3,279,285**
B 656	150,265	204,399	113,349	30	146	468,189	150,886
A 700	1,038,825	2,529,882	134,981	202	1,790	3,705,680	1,057,363
A 702	445,145	1,275,555	55,159	138	1,910	1,777,907	513,667
A 704	5,292	52,264	595	1	211	58,363	21,201
A 706	2,179	28,477	280		57	30,993	11,164
B 706	20,961	82,899	4,134	2	107	108,103	29,511
B 708	84,641	264,255	10,701	45	196	359,838	141,352
A 750	496,573	395,260	33,211	1,228	780	927,052	350,013
A 752	648,069	714,098	17,642	21	5,313	1,385,143	455,291
A 754	92,355	367,910	6,600	3	2,920	469,788	147,733
A 800	81,758	12,753	1,346	1,635	307	97,799	47,526
A 802	195,465	109,797	3,016	59	16,358	324,695	193,383
A 804	219,004	155,735	1,735	6	9,238	385,718	160,195
July Total	**2,741,643**	**4,206,861**	**10,086,642**	**3,051,734**	**72,823**	**20,159,703**	**3,291,716**
A 550	258,172	327,962	938,470	39,150	775	1,564,529	106,910
B 558	106,104	145,864	3,312,159	152,810	2,611	3,719,548	178,135
A 600	378,267	391,674	1,590,852	264,670	5,166	2,630,629	266,891
A 602	590,942	361,086	88,829	79,796	2,079	1,122,732	164,100
B 608	29,296	149,833	3,244,282	544,217	14,064	3,981,692	286,713
A 650	9,871	15,058	12,099	38,439	888	76,355	12,760
B 656	1,681	109,597	698,857	426,923	7,823	1,244,881	389,364
A 656	79,106	104,536	158	279	154	184,233	27,180
B 658	1,373	11,394	26,890	38,375	1,712	79,744	13,640
A 658	192,171	515,299	578	163	332	708,543	46,714
A 700	347,914	80,881	11,909	7,639	672	449,015	308,055
A 702	134,660	35,445	3,187	582	241	174,115	92,130
B 706	2,207	32,780	101,282	857,729	14,151	1,008,149	395,856
A 706	10,287	202,573	1,079	2	288	214,229	55,900
B 708	60,526	54,286	36,839	438,528	6,178	596,357	281,310
A 708	106,307	709,604	2,909	20	1,427	820,267	149,481
A 750	157,450	28,044	3,609	20,931	470	210,504	87,847
A 752	680	790	5		60	1,535	1,490
B 756	91	1,152	1,128	38,718	342	41,431	12,351
B 758	6,054	7,760	3,616	89,162	1,111	107,703	72,571
A 800	153,338	31,516	3,980	11,424	356	200,614	108,146
A 802	41,084	52,958	2,347	151	4,488	101,028	56,147
A 804	24,568	53,888	319	5	5,441	84,221	29,158
A 806	15,818	100,672	250	5	653	117,398	46,557
B 808	33,676	682,209	1,009	2,016	1,341	720,251	102,310
August Total	**1,198,069**	**1,211,066**	**1,352,596**	**697,611**	**20,016**	**4,479,358**	**922,126**
A 550	149,325	110,710	35,905	20,601	466	317,007	65,830
B 558	28,725	196,558	946,630	143,377	5,145	1,320,435	231,277
A 600	43,014	57,872	36,924	71,303	1,729	210,842	57,345
A 602	361,506	243,058	58,962	134,795	2,499	800,820	184,110
B 608	109,104	120,513	255,880	190,221	6,231	681,949	179,495
A 650	5,280	13,194	2,387	28,984	401	50,246	14,900
A 652	481,285	438,692	8,969	61,587	2,183	992,716	169,399
B 658	302	9,458	6,307	39,391	1,043	56,501	13,410
A 702	19,528	21,011	632	7,352	319	48,842	6,360
Grand Total	**9,246,828**	**16,095,787**	**11,872,576**	**3,752,722**	**133,979**	**41,101,892**	**9,329,871**

† See Figure 1 for areas.

The research was conducted by a biologist of the Fisheries Agency on board each vessel in co-operation with the crew members. The research vessels cruised over large areas, covering the outside of the commercial fishing grounds, in order to obtain scientific data. The cruise map is given as Figure 2.

The period of research and number of stations covered were as follows:

Name of boat	Left Hakodate	Began investigations	Entered Adak	Left Adak	Finished investigations	Entered Hakodate	No. of stations
Takuyo Maru	May 8	May 12	June 23	July 4	Aug. 12	Aug. 18	41
Etsuzan Maru	May 7	May 16	June 23	July 4	Aug. 10	Aug. 18	41
Eiko Maru	May 7	May 23	June 23	July 4	Aug. 11	Aug. 20	53

Both gillnets and long lines were carried by the research vessels but the long lines were used only once and no salmon were caught.

Gillnets of five different mesh sizes were used, namely 2.5, 3.0, 3.5, 4.0 and 4.5 sun†. The amount of gillnets used by each research vessel varied, depending on the time and place, but can be summarized as follows:

Name of boat	2.5 sun	3.0 sun	3.5 sun	4.0 sun	4.5 sun	Average
Takuyo Maru	2 - 5 tan	2 - 6 tan	6 - 8 tan	25 - 139 tan	4 - 6 tan	110
Etsuzan Maru	2 - 4 tan	3 - 6 tan	5 - 10 tan	60 - 305 tan	2 - 5 tan	191
Eiko Maru	2 - 5 tan	4 - 6 tan	4 - 8 tan	64 - 262 tan	4 - 6 tan	186

Catches by each research vessel were as follows:

Name of boat	Sockeye	Chum	Pink	Coho	Chinook	Total	Nets used (in tan)§
Takuyo Maru	5,518	3,099	1,787	1,630	56	12,090	4,553
Etsuzan Maru	5,449	7,248	778	1,267	66	14,808	7,853
Eiko Maru	6,583	13,050	2,502	1,305	60	23,500	9,487
Total	17,550	23,397	5,067	4,202	182	50,398	21,893

§ One tan of net equals about 165 feet.

Detailed data on catches made by each government research vessel, such as date and location of fishing, surface water temperature, direction of net, number of tans used, catch by species and catches of other species of fish are shown in Tables 3 to 5.

2. IDENTIFICATION OF STOCKS.

A. Morphological and Meristic Studies.

(a) Analysis of the Commercial Catches.

Measurements were made of the specimens sampled on sixteen motherships, of which twelve operated in the waters offshore east of Kamchatka and in the vicinity of the Aleutian Islands, two in the waters off Cape Oliutorski and two in the Okhotsk Sea. Thirty specimens each of chum and sockeye were sampled daily on each mothership, fork lengths were measured, weights recorded, sex determined and scales sampled. Furthermore, gonads were weighed for half of the specimens. On several motherships measurements were also made on spring and pink salmon.

The compilation of these data by week and by area is proceeding. For the purpose of compiling the measurement data the whole fishing ground is divided into four areas, namely Oliutorski area, Aleutian area, East Kamchatka area and West Kamchatka area.

(i) **Length composition by age.**

(Age composition.)

The data on the length and age of the fish caught by motherships are being compiled in the following way. For one-fifth of the specimens collected as mentioned above, the age is determined and the age composition of each length class is determined by area and week. Meanwhile the length composition by sex, area and week is determined for all the specimens meas-

† One sun equals 1.19 inches.

TABLE 3. Salmon investigation in the North Pacific in 1956—*Takuyo Maru.*

Date of Fishing	Position		Surface W.T.	Direction of Nets	Nets Used in Tan	Catch in No. of Fish						Other Species
	Lat.	Long.				Sockeye	Chum	Pink	Coho	Chinook	Total	
5 - 13	39 - 55N	164 - 25E	15.2	SSE	92						0	Bramidae 106, Albacore 34, Squid 32
5 - 17	39 - 45N	173 - 47E	13.9	NNW	62						0	Bramidae 98, Squid 130
5 - 19	43 - 00N	175 - 11E	11.0	NE/E	62		9	28			37	*Prionace* 1, *Lamna* 5
5 - 23	42 - 31N	165 - 33E	7.9	N	92		11	14			25	*Lamna* 2
5 - 26	45 - 19N	164 - 15E	5.0	NE	50	81	83	30			194	
5 - 28	45 - 20N	170 - 02E	6.9	SE/E	50	55	5	54	5		119	
5 - 30	45 - 36N	174 - 17E	5.2	SE/E	50	96	19	12	10		137	*Lamna* 1
5 - 31	46 - 50N	175 - 27E	6.0	N	90	52	24	42		1	119	Porpoise 2
6 - 5	48 - 59N	174 - 56E	5.2	SW/S	90	16	60	49			125	Hexagrammidae 2
6 - 6	50 - 25N	173 - 31E	5.2	W	92	21	219	21		1	262	*Theragra* 3, Lamprey 1
6 - 14	48 - 33N	172 - 16E	5.2	NE/E	92	195	112	46			353	Hexagrammidae 2
6 - 16	48 - 52N	177 - 11E	5.3	E	92	90	60	16	5		171	
6 - 17	49 - 34N	177 - 29E	5.6	SW/S	92	15	81	5	1		102	*Lamna* 1
6 - 18	49 - 50N	179 - 27E	5.5	SW	92	29	11	1	1	2	44	*Lamna* 1
6 - 19	50 - 15N	178 - 24W	5.7	E/N	60	47	98				145	*Lamna* 1
6 - 21	52 - 27N	177 - 50W	5.4	E	56	43	1	1			45	*Theragra* 13
6 - 22	52 - 13N	176 - 31W	5.5	SW	56	16	13	1			30	*Theragra* 9
7 - 6	54 - 55N	179 - 42E	6.5	E/N	60	10	135	2			147	*Theragra* 4
7 - 13	46 - 10N	168 - 26E	8.4	NE/E	80		63	156	51	1	271	Bramidae 20, *Squalus* 1, Squid
7 - 14	46 - 06N	168 - 08E	8.4	NE/E	158		156	320	83		559	Squid 7, Bramidae 85 *Squalus* 1
7 - 15	46 - 06N	168 - 00E	9.2	W/S	160		35	71	37		143	Bramidae 23, Squid 1
7 - 16	46 - 18N	168 - 02E	9.6	SE	160		74	74	41		189	Bramidae 60, Plagyodontidae 2, Squid 11
7 - 17	46 - 25N	168 - 07E	9.6	SW/S	160		71	227	166	14	478	Bramidae 93, *Lamna* 1, Squid 6
7 - 18	46 - 36N	167 - 58E	10.2	SW	160		93	349	454	6	902	Bramidae 148, Squid 7
7 - 20	46 - 43N	167 - 43E	10.6	SW/S	157		126	66	73	12	277	Squid 14, Bramidae 156, *Squalus* 4
7 - 24	53 - 00N	169 - 41E	8.7	NNW	150		64	9	37	2	313	*Lamna* 1
7 - 25	53 - 51N	169 - 46E	9.0	NW/N	149	590	231	2	3	2	828	*Theragra* 13, *Lamna* 1
7 - 26	53 - 32N	167 - 52E	8.0	SE/E	80	252	42	2	6	1	303	*Theragra* 1, *Plagyodus* 1
7 - 28	53 - 52N	164 - 20E	8.8	NE/N	80	196	105	8	24		333	*Lamna* 1
7 - 29	53 - 00N	162 - 45E	9.2	N/W	149	227	83	13	74	2	399	*Theragra* 1, *Lamna* 2
7 - 30	52 - 57N	164 - 10E	9.8	W/S	150	531	63	13	70	1	678	*Theragra* 1
7 - 31	53 - 07N	166 - 08E	9.1	WNW	150	598	53	2	24	2	679	*Squalus* 1
8 - 1	53 - 05N	167 - 25E	9.4	NW/W	150	588	159	4	22	1	774	*Theragra* 1
8 - 2	53 - 06N	167 - 17E	9.4	NNE	150	237	132	10	37	2	418	(Kitsume) 2
8 - 4	53 - 15N	166 - 47E	9.6	NNW	150	284	79	9	22		394	
8 - 5	53 - 21N	166 - 13E	9.6	N/W	150	461	78	4	22	1	566	
8 - 6	53 - 16N	165 - 40E	10.9	ESE	150	317	64	1	27		409	*Icticus* 1
8 - 7	53 - 24N	165 - 27E	10.6	N	150	197	98	1	57		353	*Lamna* 1
8 - 9	51 - 24N	163 - 20E	11.4	NE/E	150	2	229	13	75	2	321	(Kitsume) 1, *Lamna* 1
8 - 10	50 - 33N	162 - 30E	12.0	N/W	150	21	45	49	136	2	253	Common squid 2, *Squalus* 2 Bramidae 1
8 - 11	49 - 14N	160 - 24E	12.2	N	80		15	62	67	1	145	Squid 10
Total					4,553	5,518	3,099	1,787	1,630	56	12,090	

TABLE 4. Salmon investigation in the North Pacific in 1956—*Etsuzan Maru.*

Date of Fishing	Position		Surface W.T.	Direction of Nets	Nets Used in Tan	Catch in No. of Fish						Other Species
	Lat.	Long.				Sockeye	Chum	Pink	Coho	Chinook	Total	
5 - 18	39 - 56N	171 - 12W	12.6	NW/W	180			—				Bramidae 5, *Lamna* 1, Squid 1
5 - 24	42 - 35N	170 - 03W	9.8	NW/N	181			10			10	*Lamna* 3
5 - 27	42 - 30N	175 - 04W	10.8	SSW	60			10			10	
5 - 29	42 - 42N	178 - 20W	10.4	E/N	180		1	10		1	12	Bramidae 115, *Lamna* 3
5 - 31	45 - 54N	179 - 52W	6.7	ENE	330	6	144	26		20	196	
6 - 4	46 - 30N	175 - 08W	5.4	SW/W	120	21	17	45		1	84	*Lamna* 2
6 - 7	46 - 00N	165 - 05W	7.8	W/N	120	9	55	35	10	8	95	*Lamna* 3, Porpoise 1
6 - 9	49 - 10N	165 - 21W	5.8	W/N	318	47	212	65	1	1	326	
6 - 14	48 - 56N	179 - 43W	5.5	SW/W	318	23	33	15			71	*Lamna* 2
6 - 16	50 - 21N	175 - 34E	5.0	SW	180	156	237	50		2	445	*Lamna* 3
6 - 17	51 - 15N	173 - 00E	5.1	NNE	317	159	307	31			497	*Lamna* 3
6 - 18	52 - 01N	172 - 35E	5.2	N/W	186	41	131	6			178	
6 - 19	51 - 59N	171 - 24E	4.9	NW/W	180	6	38	6			50	*Theragra* 7
6 - 21	53 - 08N	177 - 37E	5.4	NW/N	194	96	42	2			140	*Theragra* 30
6 - 22	52 - 43N	179 - 15W	5.3	NNE	235	417	287	8			712	*Theragra* 28
6 - 30	52 - 08N	176 - 35W	6.4	SSE	60	2					2	
7 - 5	55 - 00N	179 - 40W	7.2	NW	240	83	61	1			145	*Theragra* 10, *Lamna* 2
7 - 6	54 - 37N	179 - 04E	6.4	W/S	237	53	226	4		1	284	*Theragra* 15, *Lamna* 3
7 - 8	55 - 44N	171 - 34E	6.8	N/W	237	62	183	3	1	1	250	*Theragra* 20
7 - 14	48 - 25N	170 - 29E	8.7	S/E	292	6	130	15	202	2	355	
7 - 15	48 - 52N	170 - 30E	8.8	N/W	296	4	31	12	98	2	147	*Theragra* 3
7 - 16	47 - 36N	169 - 24E	8.9	ENE	180		11	19	34	2	66	
7 - 17	46 - 01N	169 - 48E	8.9	S/E	190		20	54	171	4	249	(Tetsuatama), Bramidae 120
7 - 18	46 - 05N	168 - 41E	11.1	S/E	306		20	15	82		117	Bramidae 100
7 - 19	46 - 46N	167 - 36E	10.2	SE	242		123	109	194		426	Bramidae 80
7 - 20	47 - 10N	168 - 31E	9.8	SW	239		57	214	294	3	568	(Tetsuatama) 4, Lamprey 1, Bramidae 40
7 - 25	57 - 00N	169 - 44E	8.2	SE	150	146	871				1,017	*Salvelinus malma* 112, *Theragra* 30
7 - 26	57 - 59N	168 - 22E	8.3	NW	149	221	632	1		1	860	*S. malma* 28, *Theragra* 80
7 - 27	57 - 57N	169 - 50E	8.8	W/S	149	326	796				1,122	*S. malma* 33, *Theragra* 7
7 - 28	59 - 15N	169 - 51E	8.7	S/W	149	117	150	1			268	*S. malma* 88
7 - 29	58 - 52N	167 - 50E	10.4	W	148	474	237		1		712	*S. malma* 11, *Theragra* 2
7 - 30	57 - 58N	166 - 16E	9.4	SW/W	150	142	102		5		249	*S. malma* 11
7 - 31	56 - 51N	166 - 17E	9.7	W/S	150	252	207				459	*S. malma* 23
8 - 1	56 - 40N	167 - 55E	9.0	SE	150	101	154		5		260	*S. malma* 140
8 - 2	57 - 16N	168 - 12E	9.9	SE	150	157	86	1	2	3	249	*S. malma* 243
8 - 4	54 - 04N	169 - 11E	9.9	SE/S	150	117	467	1	13	1	599	*S. malma* 1
8 - 5	53 - 57N	169 - 07E	9.9	S	146	382	193	1	51		627	
8 - 6	53 - 56N	169 - 32E	10.0	SSE	150	590	381	2	42	3	1,018	
8 - 7	53 - 43N	169 - 53E	10.7	SE	150	386	300	2	14	7	709	Several *Theragra*, *Lamna* 1
8 - 8	53 - 45N	169 - 34E	10.6	SSE	150	322	106		28	1	457	Several *Theragra*
8 - 9	53 - 09N	170 - 19E	10.3	SSE	150	520	222	4	19	2	767	(Tetsuatama) 5, Lamprey 1
Total					7,853	5,449	7,248	778	1,267	66	14,808	

TABLE 5. Salmon investigation in the North Pacific in 1956—*Eiko Maru*.

Date of Fishing	Position		Surface W.T.	Direction of Nets	Nets Used in Tan	Catch in No. of Fish						Other Species
	Lat.	Long.				Sockeye	Chum	Pink	Coho	Chinook	Total	
5 - 23	49 - 00N	174 - 5 E		NE	242	120	673	0	0	4	797	
5 - 25	49 - 00N	177 - 00E	4.3	WNW	80	14	17	0	0	0	31	
5 - 26	48 - 50N	178 - 50E	5.0	SW	170	31	54	6	0	0	91	
5 - 27	48 - 50N	179 - 05W	5.0	NNE	91	19	155	10	0	0	184	
5 - 29	47 - 30N	178 - 50E	5.2	N	230	28	31	72	0	0	131	
5 - 30	47 - 30N	177 - 05E	5.0	WNW	86	9	40	14	0	0	63	
5 - 31	48 - 13N	175 - 41E	5.0	NE	230	193	153	68	0	0	414	
6 - 1	49 - 38N	176 - 02E	4.6	NE	83	13	30	0	0	0	43	
6 - 2	50 - 35N	174 - 45E			83	3	18	0	0	0	21	
6 - 4	52 - 07N	172 - 41E	4.7	SE/S	279	180	482	3	0	0	665	
6 - 5	53 - 13N	172 - 45E	4.4	ENE	278	56	787	0	0	2	845	
6 - 6	53 - 33N	174 - 45E	4.5	WNW	278	399	2,158	65	0	0	2,622	Hexagrammidae 20 - 30
6 - 7	53 - 41N	175 - 00E	4.1	ENE	278	115	1,327	126	0	0	1,568	Hexagrammidae 20, *Theragra* 5 - 6
6 - 8	54 - 53N	175 - 00E	4.0	NE	83	18	57	2	0	0	77	
6 - 9	56 - 22N	175 - 12E	4.1	NE/E	278	103	432	11	0	0	546	
6 - 12	56 - 45N	179 - 40E	4.1	WSW	278	198	648	25	0	0	871	
6 - 13	55 - 22N	179 - 30E	4.2	NE/E	83	31	308	9	0	0	348	
6 - 14	53 - 39N	179 - 58W	4.6	SSE	135	163	54	9	0	0	226	
6 - 15	53 - 53N	177 - 23W	5.1	WSW	278	199	153	10	0	0	362	Fur seal 1
6 - 16	53 - 29N	175 - 09W	5.6	NE/N	83	220	33	2	0	1	256	
6 - 17	54 - 50N	175 - 00W	6.1	N	278	485	86	10	0	26	607	
6 - 18	56 - 20N	175 - 08W	5.0	N	277	515	183	6	0	1	705	
6 - 19	57 - 45N	175 - 11W	5.3	W	277	678	684	9	0	3	1,374	
6 - 21	53 - 56N	176 - 45W			10						0	*Theragra* 22
6 - 30	52 - 20N	176 - 00W			288	3					3	
7 - 5	53 - 50N	179 - 45W	6.9	E	280	98	116	2			216	
7 - 6	53 - 36N	178 - 30E	7.0	WSW	280	41	85			2	128	Fur seal 1
7 - 7	53 - 42N	176 - 11E	7.0	WNW	101	15	14		1		30	
7 - 9	50 - 58N	172 - 33E	7.3	E	179	96	44	1			141	
7 - 12	47 - 52N	173 - 00E	8.4	SW	279		6		21	1	28	
7 - 16	46 - 44N	168 - 16E	9.0	NNE	229		20	160	163	4	347	Squid 3, Bramidae
7 - 17	46 - 50N	168 - 27E	9.4	NNE	222		45	712	727		1,484	Steelhead 5, Bramidaes, *Cololabis* 1
7 - 18	46 - 52N	168 - 23E	9.5	NNE	220		21	287	170	1	479	Steelhead 2
7 - 19	46 - 50N	168 - 05E	10.2	S	220		65	225	57	8	355	Bramidae, approx. 10
7 - 20	46 - 57N	167 - 54E	10.0	NNE	220		22	175	39		236	Bramidae, approx. 10
7 - 24	53 - 04N	168 - 55E	8.9	S	149	282	41	2	8	5	338	
7 - 25	54 - 48N	169 - 35E	9.3	S	150	98	72	4			174	
7 - 26	56 - 00N	169 - 47E	8.6	NNW	150	109	259		2		370	*Squalus* 1, *S. malma* 4
7 - 27	56 - 06N	168 - 02E	8.8	SW/S	150	185	1,225	3	2		1,415	*S. malma* 10, unknown sp. 1
7 - 28	56 - 14N	166 - 44E	9.4	NNE	150	369	308	3	2		682	
7 - 29	56 - 12N	164 - 55E	12.0	SSW	150	166	285	3	2		456	*Squalus* 1, Porpoise 2
7 - 30	55 - 25N	164 - 30E	9.8	SSE	150	198	185	2	1		386	
7 - 31	56 - 03N	165 - 00E	10.5	S	150	127	104	2			233	
8 - 1	56 - 10N	167 - 57E	9.7	SE	150	72	175	60			307	
8 - 2	55 - 35N	168 - 07E	9.4	SSE	150	57	105	58			220	
8 - 3	54 - 10N	168 - 42E	9.3	SSW	150	40	543	46			629	
8 - 4	54 - 05N	168 - 47E	9.3	S/E	150	23	129	40	2	1	195	
8 - 5	53 - 36N	167 - 51E	9.7	S	150	140	80	65	8		293	Lamprey 1
8 - 6	53 - 42N	167 - 40E	10.2	NNW	150	308	128	55	5	1	497	
8 - 7	53 - 55N	167 - 20E	10.0	NW/W	150	100	139	21	3		263	
8 - 8	53 - 26N	166 - 48E	9.8	N	150	60	40	27	3		130	
8 - 9	52 - 34N	165 - 18E	10.4	SSW	150	120	170	53	63		406	
8 - 10	52 - 20N	165 - 20E	10.6	SSW	150	89	61	39	26		215	
Total					9,487	6,583	1,350	2,502	1,305	60	23,500	

ured. The age composition of all the specimens measured is estimated by applying the age composition of each length class to the length composition of all specimens. Age composition graphs by area and by week for sockeye, chum, pink and coho salmon are being prepared in this way. The results are not yet available for publication. It is possible to use the age compositions of sockeye salmon for the purpose of distinguishing various stocks by determining the fresh water and sea-water ages separately.

(ii) **Gonad Weights.**

The data on gonad weights of sockeye salmon are being analyzed in a different way from the data for other species. The frequency distributions of gonad weights of sockeye salmon are being compiled by month and by sex for each mothership, in an attempt to separate immature fish from mature fish by tracing changes in the frequency distributions of gonad weights. For chum, pink and coho salmon, on the other hand, tables showing correlations between gonad weights and fork lengths are being prepared by sex, area and week. Frequency distributions of gonad weights by sex, area and month are also being made for chum and pink salmon.

(b) **Analysis of Catches by the Research Vessels.**

For the identification of salmon stocks measurements were made and scales were collected on the research vessels. The scale reading is not yet finished. For measurements 30 specimens each of sockeye, chum, pink, coho and spring salmon were sampled daily and fork lengths, gonad weights and body weights were taken and the sex determined. In order to determine the distribution of young salmon the length distributions of catches of each research vessel were compiled by area, period, species and sex.

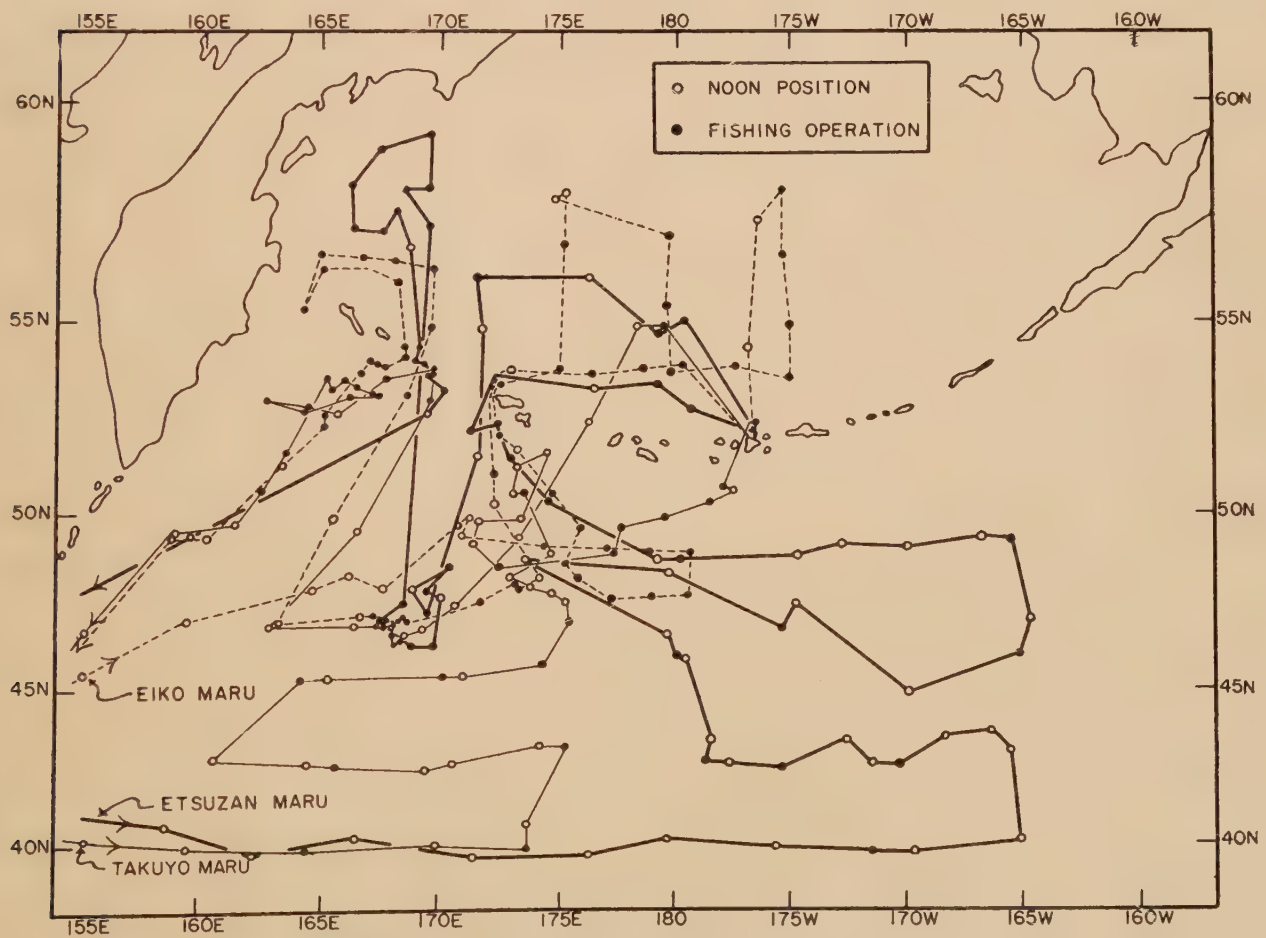

Fig. 2. Cruise map of Japanese research vessels, 1956.

Figures 3 to 6 show the length compositions by species of the total catch of each research vessel.

Small sockeye and chum salmon, 30 to 40 cm., in fork length, were caught in considerable amounts in various periods and areas. Not considering relative densities of the distribution, it should be realized that juvenile fish of these two species are widely distributed over the northern waters of the North Pacific.

The length compositions of the fish caught by nets of different mesh sizes (2.5, 3.0, 3.5, 4.0 and 4.5 sun) were compiled. The result shows that it is necessary to use 2.5 sun mesh to catch young salmon of about 30 cm. in fork length. Naturally the larger fish were caught by nets of larger mesh sizes.

(c) **Studies of Scales.**

(i) **Sockeye.** In sockeye salmon the scale pattern can be used as a character to identify the stocks because the length of freshwater life and that of marine life is different according to stocks. Therefore the age of sockeye salmon shown by two different phases of life history is an important characteristic of sockeye scales. Studies on characteristics of age composition, their seasonal variations in relation to movements of fish and comparisons of age compositions between fish from different areas were made.

(ii) **Chum.** Fundamental studies on the chum scale are now being conducted.

(iii) **Pinks.** In some previous studies several scale types of pink salmon were distinguished depending upon differences in the distribution of circuli. However, the criteria for classifying scales into different types were not objective in these studies. In the present study numbers

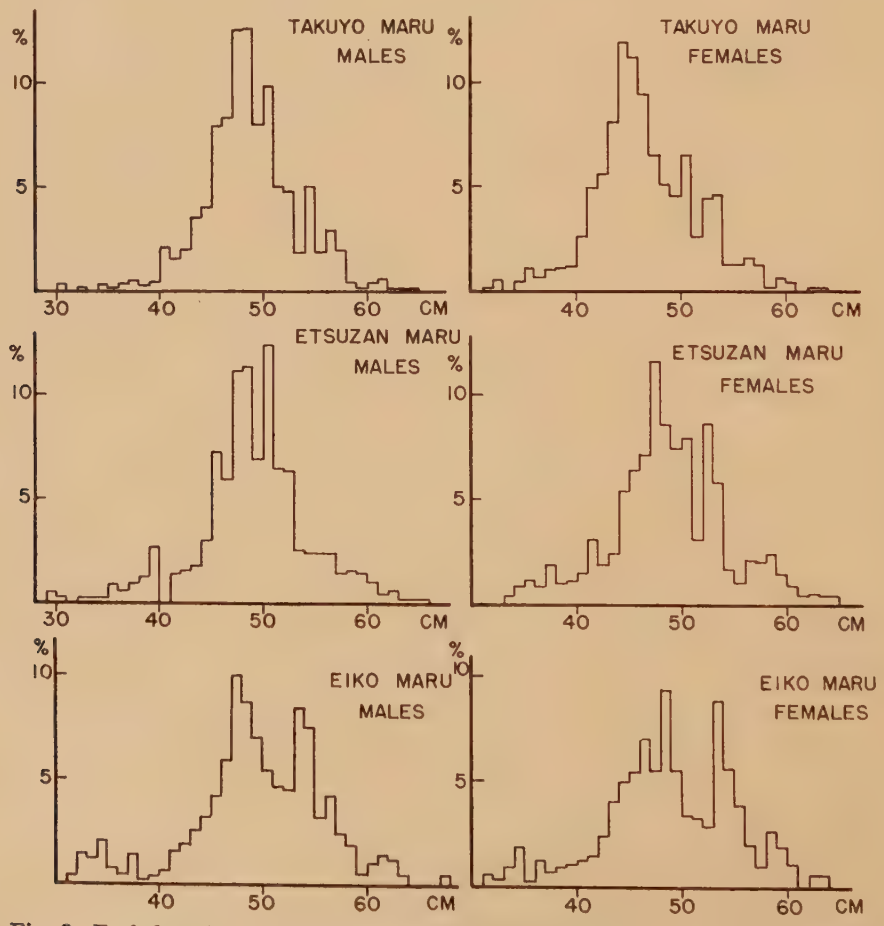

Fig. 3. Fork length composition of sockeye salmon caught by research vessels in 1956.

of circuli and their intervals are compared between samples from different areas.

B. **Biochemical and Physiological Studies.**

Local differences in colors of salmon flesh were examined. Colors of flesh near the backbone were measured by the Armstrong Colorimeter for chum and sockeye salmon. Differences in colors depending on sex, age, length and weight are now being studied.

Blood samples of nearly two hundred salmon, comprising five species, were collected by the three government research vessels and one mothership which operated in the Okhotsk Sea. For a comparison, blood samples were also collected from salmon of two rivers in Hokkaido.

In the precipitation ring test differences between species were observed but differences between fish of the same species could not be detected. By using

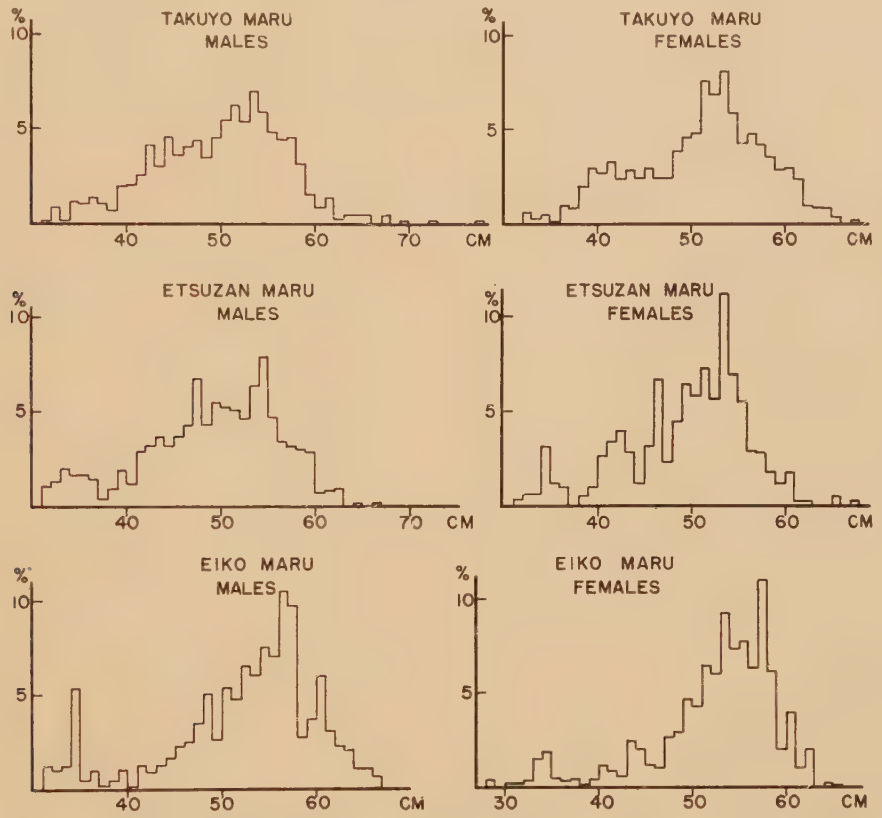

Fig. 4. Fork length composition of chum salmon caught by research vessels in 1956.

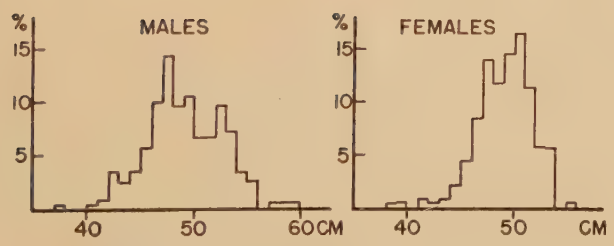

Fig. 5. Fork length composition of pink salmon caught by research vessels in 1956.

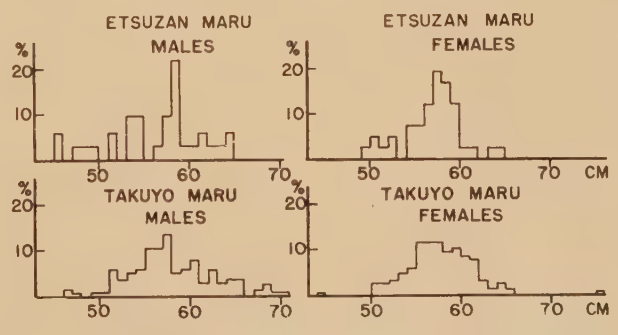

Fig. 6. Fork length composition of coho salmon caught by research vessels in 1956.

the anti-serum absorption test differences between fish from the Aleutian area, Okhotsk Sea and east coast of Hokkaido were detected in chum salmon. Differences were also observed in sockeye salmon between different areas. Studies are being made of differences between periods of sample collection and also of effects of the length of time between collection and processing of blood samples.

C. **Parasitological Study.**

In 1956 taxonomic studies were conducted on salmon parasites collected by the research vessels. These samples were preserved in a formalin solution in glass tubes. A total of 61 samples, of which 16 were from sockeye, 31 from chum, 5 from pink, 5 from coho, one from spring, one from mizuuwo *(Plagiodus* sp.*)* and two from unidentified species, were examined. The results can be summarized as follows:

No trematodes were found. All the cestodes found were in larval stages. Four species of cestodes, namely *Schistocephalus, Dibothriocephalus, Proteocephalus* and *Phyllobothrium salmonis,* were distinguished. In nematodes both adult and larval stages were found and *Anisakis salaris, Contracaecum adunsa?* were distinguished among larvae and *Philonema ochotense, Philonema oncorhynchi* and *Contracaecum benimasu* were distinguished among adult parasites. All the specimens of parasitic copepods belonged to *Lepeophtheirus uenoi. Bolbosoma* of Acanthocephala was found for the first time. Thus, a total of eleven species of parasites were identified.

In chum salmon cestodes were most abundant. In sockeye salmon adult nematodes, larvae of cestodes and some others were found. Only parasitic copepods were found from pink salmon.

It should be noted that the samples used in this study were collected on small vessels with difficulty and therefore the number of specimens examined was small. The study should be continued for a number of years and the sampling should cover important salmon rivers and lakes in the future. It is also required to conduct parasitological studies on both food and predators of salmon. These will be subjects of future studies.

3. STUDY OF MOVEMENTS BY TAGGING.

A total of 1,188 salmon of five species were tagged with pendant tags at 70 stations by the three research vessels during the period of May 27th through August 10. Numbers of fish by species tagged by each research vessel are shown in Table 6.

No recoveries have been made to date. The locations of release, etc., may account for such a result.

4. OCEANOGRAPHY.

The Government research vessels collected, at each station, plankton and water samples and carried out biological, physical and chemical studies of the ocean. In addition, the research vessel *Oshoro Maru* of Hokkaido University made closer observations of the ocean. The data are now being compiled. It is planned to analyze the materials from these two sources together in the future.

(i) **Water temperature and chlorinity.** Temperatures were recorded by reversing thermometers and chlorinities were determined after water samples were brought back to Hakodate. Numbers of stations observed by the three government research vessels were as follows:

Name of Vessel	Number of Stations
Takuyo Maru	48
Etsuzan Maru	49
Eiko Maru	52
Total	149

TABLE 6. Number of tagged fish released by species.

Name of boat	Sockeye		Chum		Pink		Coho		Chinook		Total	
	R†	E‡	R	E	R	E	R	E	R	E	R	E
Takuyo Maru	230	210	152	142	17	15	22	19	—	—	421	386
Etsuzan Maru	120	105	149	138	9	7	2	2	3	3	283	255
Eiko Maru	277	261	189	171	17	15	—	—	1	1	484	448
Total	627	576	490	451	43	37	24	21	4	4	1,188	1,089

† R—tagged fish released.

‡ E—efficient fish tagged (fish which swam away with tags).

Temperatures were observed at 0, 10, 25, 50, 75, 100, 150, 200 and 300 meter levels by the government research vessels. At some stations a BT cast was made as well as observations by reversing thermometers. The data collected by these government research vessels will be distributed as separate tables in the near future.

(ii) **Plankton.** The results of investigations on plankton collected by the research vessels in 1955 and 1956 will be distributed as separate tables in the near future. The relationship between the distribution and movements of salmon and the distribution of their food plankton will be studied when more material becomes available from future studies.

REPORT OF RESEARCH ON KING CRABS IN THE EASTERN BERING SEA

Fisheries Agency of Japan

Japanese king crab research in the eastern Bering Sea in 1956 under the International North Pacific Fisheries Commission program was conducted by a research worker aboard the crab-fishing mothership. During the fishing season he met the U.S. crab biologist and exchanged information with him.

A. Collection and Analysis of Records of Commercial Catches.

1. Records of Fishing Operations.

Records similar to those kept in previous years were collected for 1956 operations. Only tangle nets were used as fishing gear. The main fishing grounds are shown in Figure 1. The fishing grounds in 1956 were a little different from those in the previous years. They covered the waters close to Port Moller and off Cape Seniavin. Catches by month are shown in Table 1. No tanner crabs were packed in 1956. It may be noted from Table 1 that the catch per unit of effort is lower than in the previous years during May, June and July, which are supposed to be the periods of most active fishing.

2. Composition of the Catch.

The proportions of male crabs of legal size, female crabs, new shell crabs (male crabs of legal size with new shell), male crabs of undersize and tanner crabs were determined for the crabs caught by test nets in 1955 and 1956. Test nets are cast in

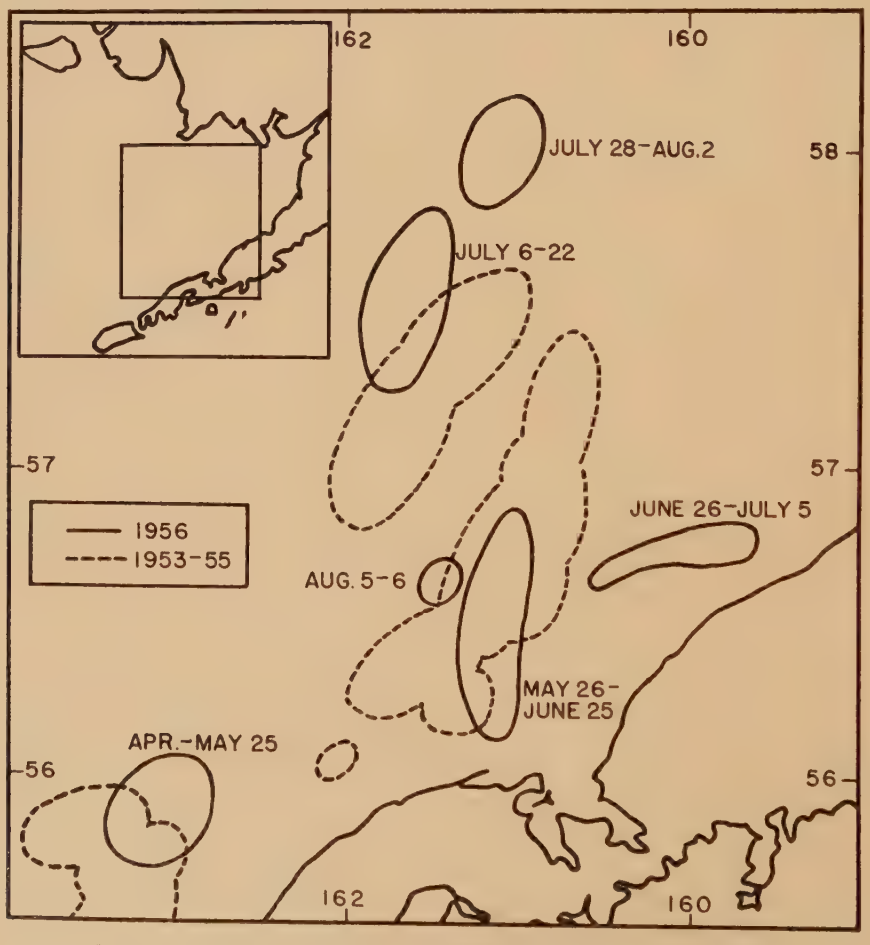

Fig. 1. Main fishing grounds, Japanese king crab fishery, 1956.

wide areas by larger vessels which navigate independently from the mothership in order to scout crab schools. Usually about fifteen sets of test nets are cast a day and are hauled after 24 hours. In making comparisons between catch compositions of 1955 and 1956 it should be noted that in 1955 a part of the fishing effort was for tanner crabs in April and only tanner crabs were fished in August and therefore the fishing grounds are more or less different in 1955 and 1956. The catch composition is shown in Table 3. In 1956 the proportion of male king crabs in April was larger than in 1955, because there was no fishing for tanner crabs in 1956. It is also noted that the proportion of male crabs during the whole season was larger than in 1955 and that the proportion of new shell crabs increased in July. The period when female crabs release old eggs and start carrying new eggs could not be determined, because this period of changing eggs seemed to be fairly long.

TABLE 1. Catch by month, 1956.

Period	* No. of "tan" hauled	No. of days net soaked	No. of crabs caught	Crabs per "tan"	No. of cases produced
April 29 - 30	3,045	3.19	16,286	5.3	737
May 1 - 31	40,300	7.63	334,673	8.3	18,429
June 1 - 30	41,223	10.15	372,776	9.0	21,578
July 1 - 31	50,729	6.30	291,244	5.7	15,560
Aug. 1 - 6	11,776	9.03	64,127	5.4	3,546
Total	147,073	7.90	1,079,106	7.3	59,850

* A "tan" is a unit of net. In the case of the king crab fishery a "tan" of crab tangle net measures about 130 feet in length at the lead line.

TABLE 2. King crab pack, 1953 - 1956 (tanner crabs are omitted).

Year	Total days fished	No. of motherships	* No. of catcher boats	** No. of kawasaki boats	No. of "tan" lifted No. of hauls
1953	119	1 (4998 G.T.)	6 (Danish seine and trawl 5)	6	106,438 2,534
1954	85	1 (4998 G.T.)	6 (trawl 5)	6	60,516 2,095
1955	126	1 (4998 G.T.)	2	6	99,157
1956	103	1 (5147 G.T.)	2	8	147,073

Year	No. of crabs caught		Crabs per "tan" Crabs per haul	*** No. of cases produced	No. of crabs per case	Note
1953	948,482 327,878	(1,276,360)	8.9 129.4	58,240	21.9	
1954	722,428 338,386	(1,060,814)	11.9 161.5	59,850	17.7	78 days for king crab
1955	1,129,163	(1,129,163)	11.4	59,850	18.9	110 days for king crab
1956	1,079,106	(1,079,106)	7.3	59,850	18.0	

* Catcher boats were used to set nets. The operations were conducted by Danish seine and trawl in 1953 and 1954, when 5 boats engaged in the operations.
** Tangle-net hauling boats which were deckloaded on the mothership.
*** 4 dozens of ½ lb. each per case, but in 1956, 49,850 cases with 4 dozens of ½ lb. and 10,000 cases with 2 dozens of 1 lb. were produced.

TABLE 3. Composition of catch by scouting nets (tangle nets), 1955 - 56.

Year	Month	No. of operations	No. of "tan" lifted	No. of crabs caught	Proportion in catch %				
					Males	Soft-shelled males	Females	Under-sized males	Tanner crabs
1955	April	109	538.5	8,312	18.9	1.7	9.0	9.0	61.3
	May	219	1,077.5	14,798	53.1	2.6	19.0	14.3	11.1
	June	268	1,340.0	16,535	60.2	2.2	16.9	13.5	7.2
	July	190	935.0	14,440	36.2	5.0	19.8	34.1	4.9
	August	145	717.0	8,121	13.6	5.3	7.0	11.6	62.7
	Total	**931**	**4,608.0**	**62,234**	**41.4**	**3.3**	**15.7**	**17.6**	**22.1**
1956	April	76	380.0	2,118	52.0	0.9	22.1	1.7	23.3
	May	200	998.5	10,056	51.8	0.8	34.3	1.7	11.4
	June	278	1,390.0	14,662	52.9	4.1	31.7	9.3	2.0
	July	236	1,185.0	10,917	46.5	13.4	13.4	24.0	2.7
	Total	**790**	**3,953.5**	**37,753**	**50.7**	**5.7**	**26.6**	**11.1**	**5.9**

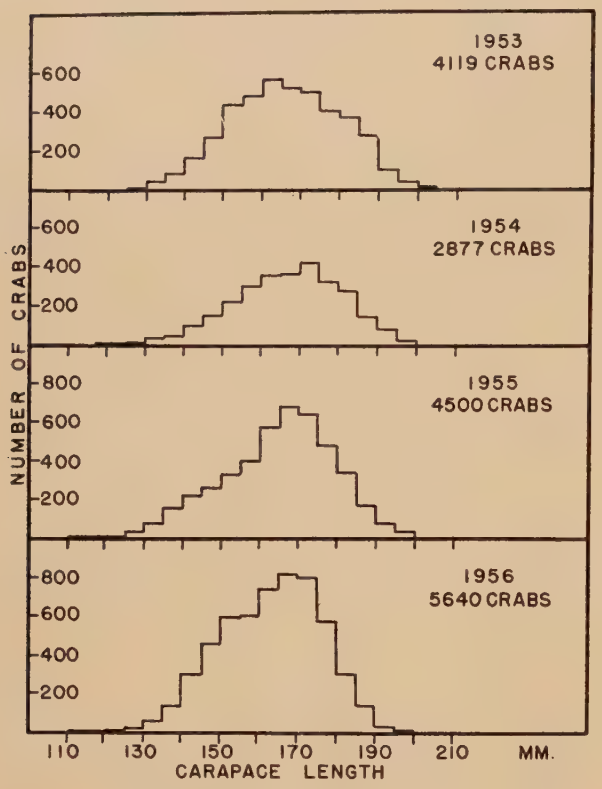

Fig. 2. Carapace length frequencies of male crabs measured aboard the mothership, 1953-1956.

B. **Identification of Stocks.**

Shell lengths and shell widths were measured on samples taken from the catches. 5,640 male crabs of legal size (not smaller than 130 mm. in maximum shell width) were measured on the mothership; the mean shell length and mean shell width were 162.51 mm. and 193.25 mm., respectively. The shell length frequency distribution with a class interval of 5 mm. is shown in Figure 2. Analysis of measurement data has not been completed.

C. **Relation of Currents to Distribution and Disposal of Young.**

Bottom water temperatures observed in 1956 are shown in Table 4. Temperatures below 0° C. were observed from April to mid-May, which is different from the observations in the previous years. Tidal currents are shown in Figure 3. The general pattern in 1955 was that during ebb-tide hours the water flowed toward the west south-west and during flood tide hours it went toward the east north-east. However, in 1956 this general pattern sometimes became obscure. At any rate velocity did not exceed 1.5 knots. A total of 203 juvenile crabs were collected during the middle of June through late June, of which 184 were smaller than 5 mm., in shell width, 9 were smaller than 15mm. and 9 were smaller than 30 mm. and 1 was measured 32.8 mm. Those juvenile crabs were attached to sea-weeds and found when tangle nets were hauled in. The positions of collection are shown in Figure 3. Measurements of these juvenile crabs have not been completed.

At each station where the mothership anchored a plankton collection was made. The examination of plankton collected showed that *Sagitta* and diatoms were most abundant followed by *Calanus plumchrus,* small copepods and euphausiids.

D. **Growth and Age Determination.**

The number of eggs carried by a female crab seems to have some relation to the age of the crab, but study of this problem has not been completed.

E. **Study of Movements by Tagging.**

In 1956 only a small number of crabs were tagged with unsatisfactory results.

F. **Determination of Fishing and Natural Mortalities.**

The study has not progressed far enough to publish any results.

Reference:

Annual Report 1955, International North Pacific Fisheries Commission, 1956, p. 44-49.

TABLE 4. Bottom water temperature and depth, 1956.

Period	* Places	Average bottom water temperature	Average depth	No. of observations
Apr. 28 - May 25	Near Amak Island	—0.49°C.	80.2 m.	27
May 26 - June 25	Off Port Moller	1.57°C.	56.1 m.	27
June 26 - July 5	Off Cape Seniavin	1.86°C.	55.8 m.	10
July 6 - July 22	Off Port Moller	2.99°C.	53.8 m.	16
July 23 - Aug. 4	Off Cape Newenham	3.95°C.	48.8 m.	13
Aug. 5 - Aug. 6	Off Port Moller	2.87°C.	—	2

* Refer to Fig. 1 as to the places.

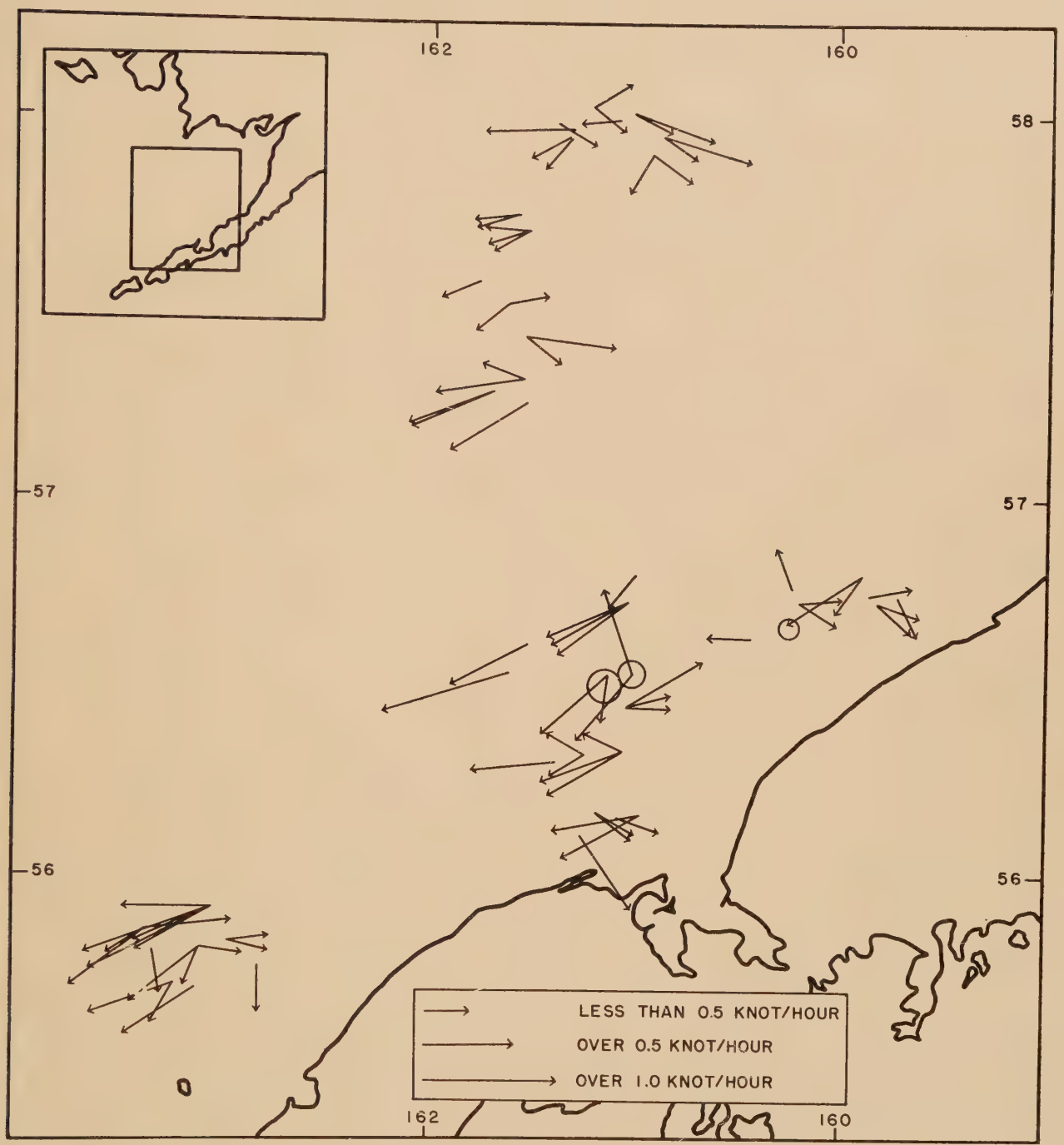

Fig. 3. Tidal currents and the locations where juvenile crabs were caught (marked by circles), 1956.

D. REPORT ON THE INVESTIGATIONS BY THE UNITED STATES FOR THE INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION — 1956

The scientific program begun by the United States in March, 1955, has now completed its first full year of study. Although we can hardly expect conclusive results from the material collected in one year, (1955), the progress made in every phase of the investigation is encouraging. Preliminary results obtained serve in two valuable ways: (1) to provide a basis for evaluating the adequacy of the research program adopted at the first meeting of the Commission in February, 1954, and (2) to guide in the planning of this year's operation in order to assure a better coverage of the North Pacific waters and to obtain more adequate samples.

Co-ordination of the research by the scientists of the three countries contributes much to the success of the program. An important factor here is the informal exchange of scientific methods, data and samples which has taken place repeatedly among those working on the Commission's program. It is hoped that this informal exchange of material will continue and even grow as the studies advance.

The same United States research agencies which participated in the program last year are continuing their studies. The investigations are co-ordinated by the U.S. Fish and Wildlife Service and major phases of the program are being conducted by the Fisheries Research Institute and the Department of Oceanography of the University of Washington. In every possible way, the United States has carried out the program assigned to us by the Commission at its last annual meeting.

SALMON INVESTIGATIONS

To fulfill obligations set forth in the Protocol of the Convention, most of the research now being done by the United States is on the distribution and movements of the salmons on the High Seas of the North Pacific and on the identification and separation of the North American and Asian stocks of salmon inhabiting these waters.

An important contribution to the progress of these studies is the co-ordinated vessel program developed at the 1955 annual meeting of the Commission. The concerted effort of the three countries has made possible an extensive coverage of the North Pacific Ocean between 40°N. and 60°N. Latitude and from the North American coast to about 300 miles from the Asian shore (Figure 1). Operation of the vessels over a longer period of time than in 1955 was a part of the joint program for this year.

Offshore Distribution of Salmon

According to plan, the United States Government chartered four vessels of the halibut schooner type (Table 1) to study the offshore distribution of salmon. Two of the vessels, the *Mitkof* and the *Tordenskjold,* left Seattle on May 14-15 and the remaining two vessels left July 5 for their respective areas. Location of the actual stations fished is found in Figure 2.

The amount of gear fished was carefully standardized so that each vessel used 18 shackles (5,400 feet) of nylon gill nets hung in an identical manner and made up of various mesh sizes, as shown in Table 2.

In addition to the chartered vessels, three U.S. Fish and Wildlife Service vessels participated in the high seas survey. The exploratory fishing vessel *John N. Cobb,* which undertook most of the work in 1955, concentrated this year on a study of the southern range of salmon and the characteristics of the ocean limiting their distribution. The *Charles H. Gilbert* obtained some very important information on the spring distribution of salmon in waters north of Honolulu, and later the *John R. Manning* explored a cross section of ocean between the Hawaiian Islands and Adak; both of these vessels are operated by the Pacific Oceanic Fisheries Investigations.

Since weather remains the most troublesome factor in fulfilling the plan of vessel operation, the number of station days lost because of weather conditions for the various months has been assembled in Table 3, as a guide for future operations. The table shows that the best months for undertaking high seas fishing in the mid and eastern North Pacific are June, July and August. In late May we can expect that the vessels may lose one out of every five fishing days due to bad weather and in early September the loss may be one day in three.

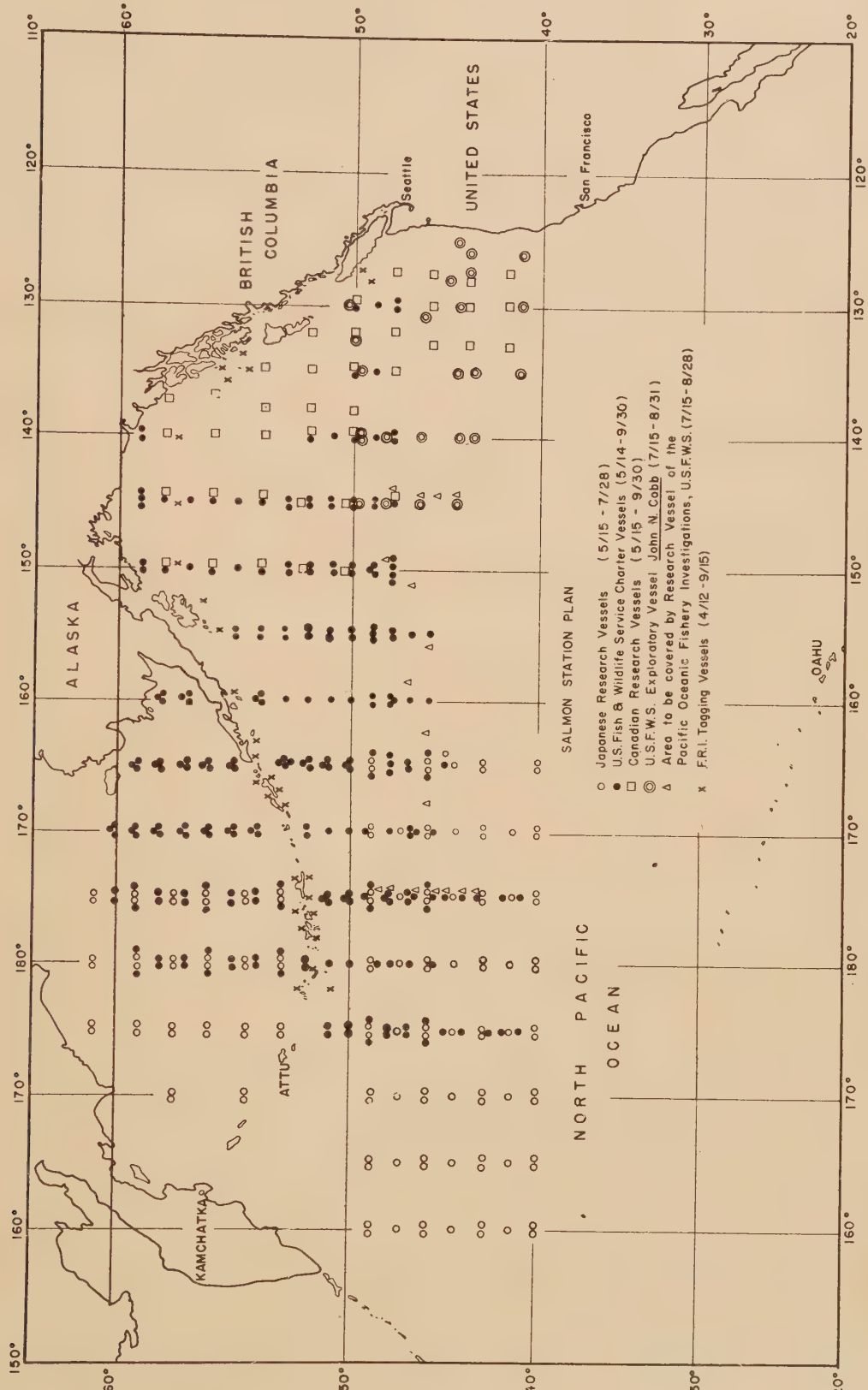
BRITISH COLUMBIA
UNITED STATES
ALASKA
Seattle
San Francisco
ATTU
KAMCHATKA
OAHU
NORTH PACIFIC OCEAN
SALMON STATION PLAN
○ Japanese Research Vessels (5/15 - 7/28)
● □ U.S. Fish & Wildlife Service Charter Vessels (5/14-9/30)
Canadian Research Vessels (5/15 - 9/30)
◎ U.S.F.W.S. Exploratory Vessel John N. Cobb (7/15 - 8/31)
△ Area to be covered by Research Vessel of the Pacific Oceanic Fishery Investigations, U.S.F.W.S. (7/15 - 8/28)
x F.R.I. Tagging Vessels (4/12 - 9/15)

Fig. 1. Salmon station plan for Japanese, Canadian and U.S. research vessels, 1956.

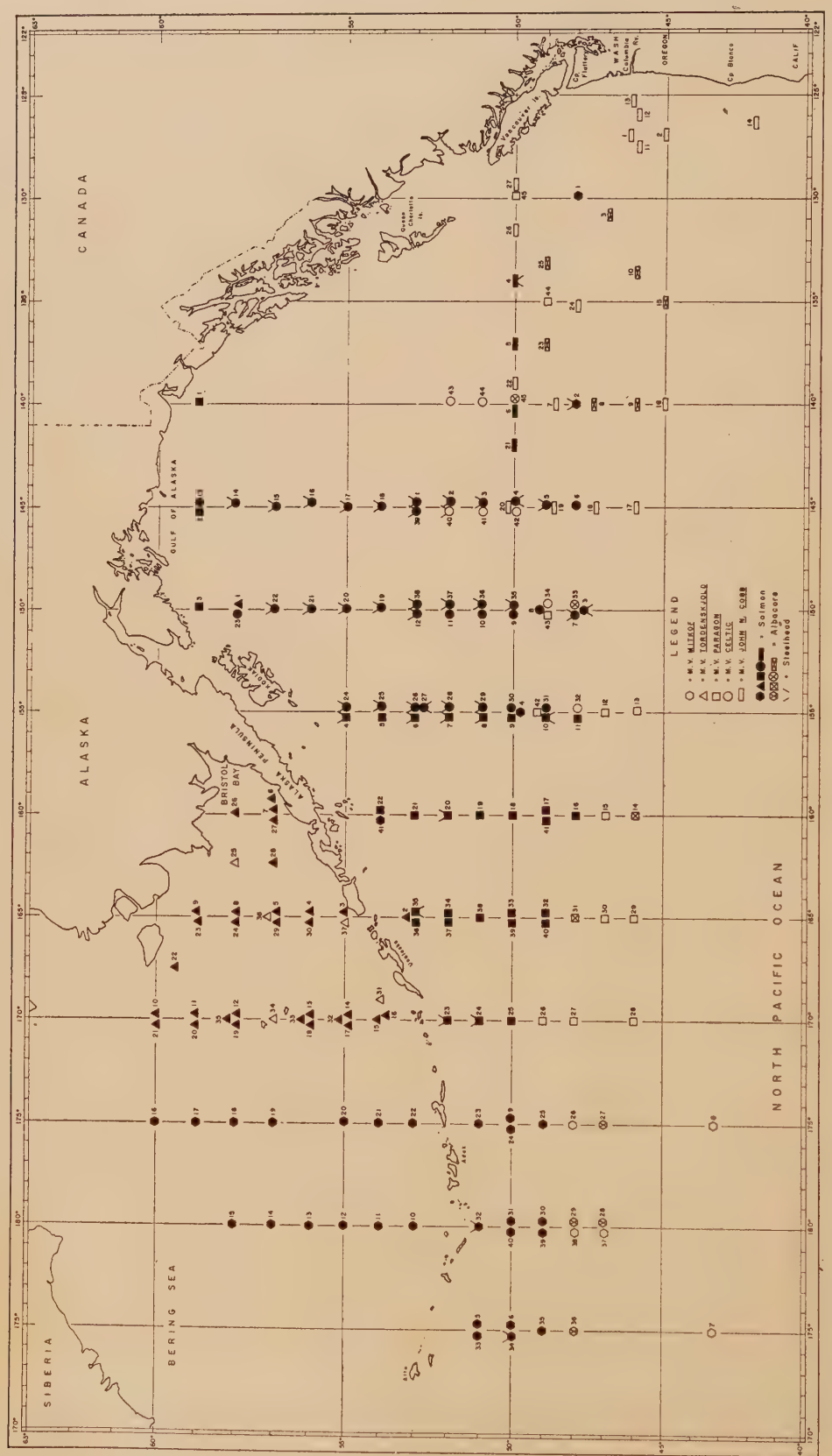

Fig. 2. Chart showing the distribution of salmon, steelhead, and albacore during the period May to September, 1956, as determined by the catches of the vessels *Mitkof*, *Tordenskjold*, *Paragon*, *Celtic* and *John N. Cobb*.

The catch for the various vessels is given in Tables 4 to 9. The abundance charts (Figures 3 and 4) plotted from the data are most interesting. The distribution of red salmon between the two periods‡ changed rapidly due to the presence of a large number of maturing salmon in the catches only during May and June. The greatest abundance of both immature red and chum salmon was around the Aleutian Islands and in the western part of the Gulf of Alaska. Of the two species, chum salmon were more widely and abundantly distributed throughout the area fished.

Pink salmon were not abundant in the area covered by the United States vessels, being found in numbers only in waters adjacent to their spawning areas, during the late spring and summer months. King and silver salmon were only occasionally taken by our vessels.

Of particular interest are the four pink salmon taken on April 23-24 by the *Charles H. Gilbert* of Pacific Oceanic Fisheries Investigations. Working out of Honolulu, this vessel had proceeded far enough north to pass into the colder waters commonly associated with salmon, which at this time of the year extended south to about 40°N. These catches confirm our belief that surface temperature is a primary factor governing the range of salmon on the high seas.

Identification of Stocks

Analysis of the 1955 collections is complete. Every method of analysis used to determine area of origin points to success in the separation of the Asian and North American stocks of salmon. Although not yet conclusive, the results do fulfill the intent of this first year's study, i.e., to find those features

‡ The two periods are from mid-May to mid-July and mid-July through August.

TABLE 1. Specifications of the vessels used for study of the off-shore distribution of salmon.

Vessel	Type	Registered Length (Ft.)	Breadth (Ft.)	Cruising Range (Miles)	Speed (Knots)
Celtic	Schooner	65.0	17.1	3,500	9.0
Mitkof	Schooner	66.1	18.4	3,600	9.0
Paragon	Schooner	80.1	19.5	4,000	8.5
Tordenskjold	Schooner	67.3	18.0	3,000	8.7
John N. Cobb	Seine	93.0	25.0	5,000	10.0
Charles H. Gilbert	Long Line	106.2	21.1	8,500	9.0
John R. Manning	Seine	79.0	22.6	6,300	7.5

TABLE 2. The number of nets of various mesh sizes fished in 1956.†

Mesh Size in Inches (Stretched)	Number of Shackles‡
2½"	3
3¼"	3
4½"	6
5¼"	6
Total	18

† Mesh sizes were fished in following order: 5¼", 4½", 3¼", 5¼", 4½", 2½", etc.
‡ One shackle is 50 fathoms or 300 feet.

TABLE 3. Effect of weather on efficiency of vessel operations.

Month	Total Boat Days	Number Boat Days Lost	Efficiency of Operations
May*	31.0	6	80.0%
June	60.0	4	93.3%
July	77.5	4	94.9%
August	108.5	7	93.6%
September**	62.0	17	72.6%

* from May 14 - 15.
** to September 15.

which differ between the various races and to evaluate the minimum degree of separation which may be expected from the four methods being tried. For the next several years the work will be devoted to refining the plan of sampling, to increasing the efficiency of the analysis and to determining fully the actual distribution of North American and Asian salmon on the High Seas.

Analysis of the meristic information reveals that the greatest differentiation between the stocks was obtained from the seven characters given in Table 10. In order to understand better the degree of separation attained from this analysis, a comparison is made between the Asian collections and the various races from North America (Tables 11-12). The results between the Asian and North American samples are expressed as the percentage of expected correct classification as indicated by the amount of overlapping of the combined meristic characteristics. This is the minimum degree of separation that may be expected; future study by each brood year and by sex should only increase the degree of separation between the races.

The most promising results have come very recently from the scale studies. By using the variations between areas for age composition, nuclear type, size and various growth zones, and the number of circuli in the various zones and combinations of zones, we have been able to assign to the correct areas about 80-90%of the red salmon scales exam-

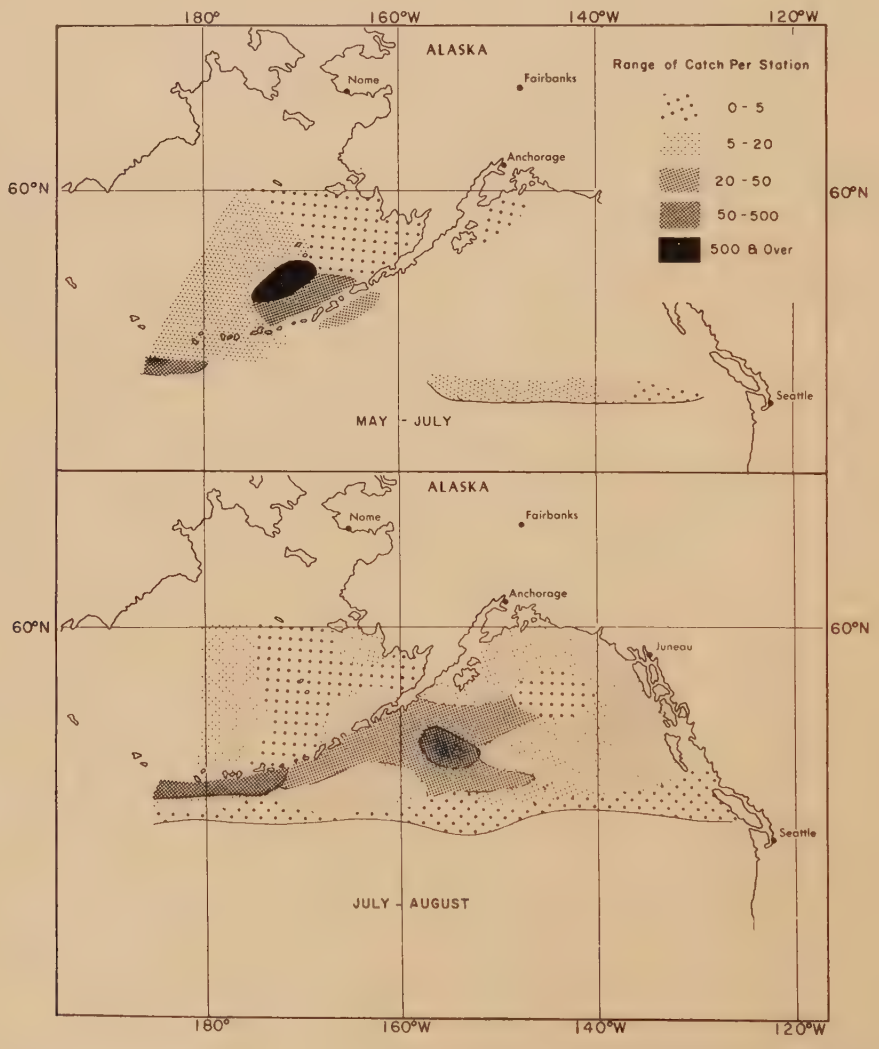

Fig. 3. Distribution of red salmon in the North Pacific during the summer of 1956.

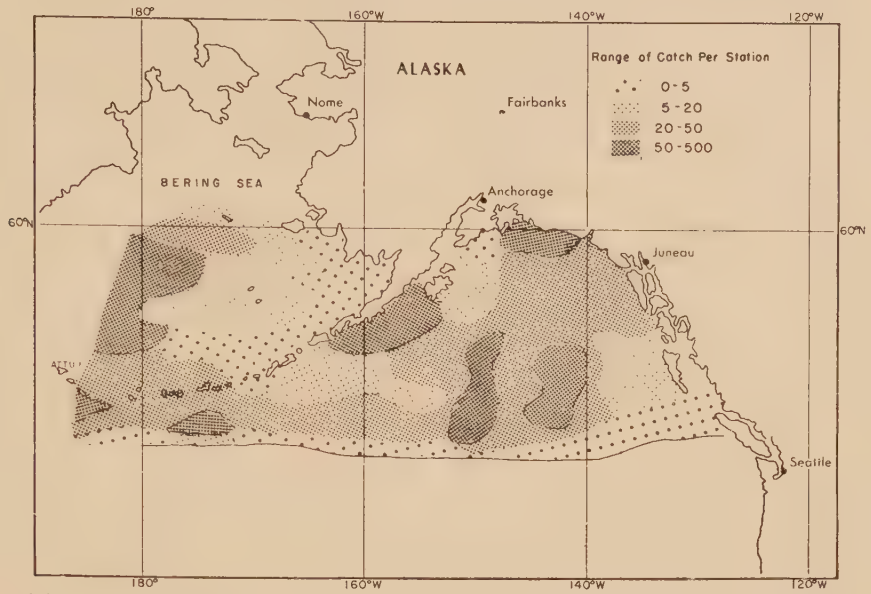

Fig. 4. Distribution of chum salmon in the North Pacific during the summer of 1956.

TABLE 4. Summary of catches taken by the vessel *Mitkof*, May - Sept., 1956.

Date	Location		Surface Temp.	Salmon Catch							
	Lat. N.	Long.	°F.	Red	Chum	King	Silver	Pink	Total	Albacore	Steelhead
May 17	48° 00′	129° 59′ W	51.6°	1			1		2		
22	48 02	140 03 W	46.9	9	7	1	1		18		2
25	47 58	150 00 W	44.2	9	5	2			16		1
28	50 00	155 04 W	41.5	6					6		
June 15	51 00	175 00 E	41.9	16	45			9	70		
16	50 00	175 00 E	41.2	91	42		1	3	137		
19	43 12	175 00 E	53.4								
22	43 11	175 00 W	54.5								
26	50 00	175 00 W	44.2	12	3	1			16		
July 6	53 00	180 00	43.9	8	9				17		
7	54 00	180 00	44.4	21	42			1	64		
8	55 00	180 00	44.6	13	128	1		1	143		
9	56 00	180 00	45.3	7	88	7			102		
10	57 00	180 00	45.8	6	21	2			29		
11	58 00	180 00	44.8	8	70				78		
13	60 00	175 00 W	46.2	3	10				13		
14	59 00	175 00 W	45.1		8				8		
15	58 00	175 00 W	49.1	14	85	3			102		
17	57 00	175 00 W	47.3	(Heavy seas — Gills and heads of salmon only—seals around nets.)							
Aug. 3	55 00	175 00 W	48.7	9	5				14		
4	54 00	175 00 W	49.1	(Two salmon heads only—seals.)							
5	53 00	175 00 W	50.5	2	36				38		
8	51 00	175 00 W	52.9	87	28	2			117		
9	50 00	175 00 W	54.5	4	58	2			64		
10	49 00	175 00 W	56.5	1	10				11		
11	48 00	175 00 W	56.3								
12	47 00	175 00 W	58.1							26	
14	47 00	180 00	63.3							4	
15	48 00	180 00	59.2							3	
16	49 00	180 00	56.1		4				4		
17	50 00	180 00	56.1		49				49		
23	51 00	180 00	44.8	162	27	6	1	1	197		2
25	51 00	175 00 E	46.2	235	88				323		1
26	50 00	175 00 E	52.2	13	27	5			45		3
27	49 00	175 00 E	53.8		21	1			22		
28	48 00	175 00 E	56.5							5	
Sept. 2	47 00	180 00									
3	48 00	180 00	53.1								
4	49 00	180 00	52.5		8				8		
5	50 00	180 00	51.1		32				32		
16	54 00	160 00 W	51.1	1	7				8		
TOTALS				738	963	33	4	15	1,753	38	9

ined. Extensive efforts are now being made to refine and improve this method because of its great promise for use in identifying the origin of individual fish.

Chum salmon from the various North Pacific areas were examined for parasites. A total of 27 kinds of parasites have been found among which at least three of these, *Anisakis* sp., *Bolbosoma* sp. and *Echinorhynchus gadi,* appear to be promising "tags" in separating the Asian and North American chum salmon.

This year, for the first time, statistically significant serological differences have been found between populations of salmon from different geographic regions. In a joint study with Dr. John Cushing of the University of California, an 80 to 90% separation was obtained between the red salmon of Bristol Bay and the Columbia River by using natural antibodies in pig sera. In another study, a system has been developed which has the advantage of utilizing whole frozen blood from salmon. The antibodies in this case are produced in rabbits. Using this system only one error was made in separating 11 Bristol Bay and 8 Okhotsk Sea red salmon samples. Although these discoveries demonstrate the use of serological methods to identify stocks of salmon, much work must yet be done before the right sera can be developed for the mass field tests required to separate effectively the Asian and North American stocks of salmon.

To overcome the limitations placed on the racial analysis because of the small sample size, a concerted effort has been made this year to increase the number of fish for every phase of study. As shown in Table 13, between two and three times the number of fish were obtained in 1956 as in 1955. The development of improved methods of handling will accelerate processing the individual fish and still provide the required accuracy.

Study of Movements by Tagging

The Fisheries Research Institute chartered two purse seine vessels, the *California Rose* (78′) and the *Renown* (85′), for the 1956 salmon tagging

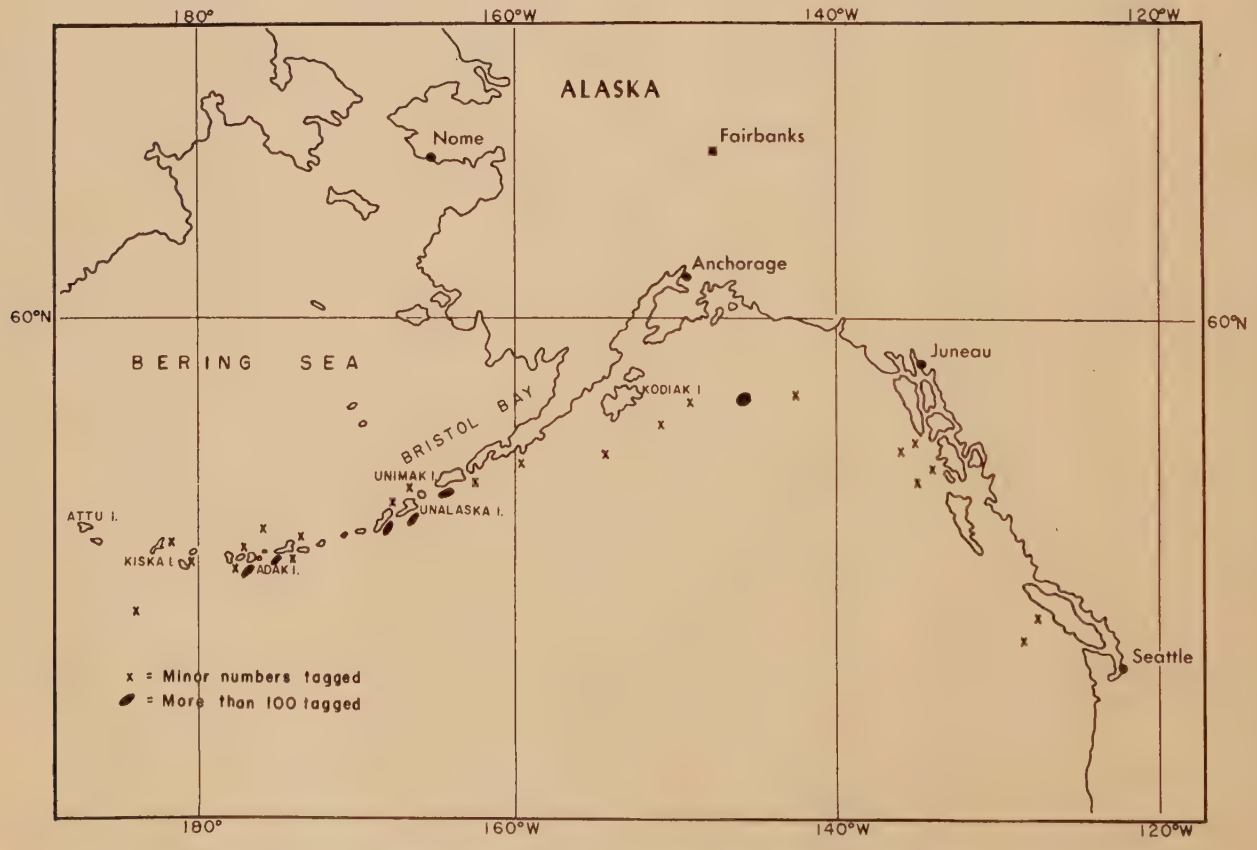

Fig. 5. Tagging locations of *California Rose* and *Renown*, 1956.

work. These vessels left Seattle April 12, and returned September 15. Because of shortage of funds, the *California Rose,* however, was committed to a fish packing charter for the period July 5 - August 5, after which she resumed the tagging contract.

1. **Fishing Gear.**

Each vessel carried the following gear:

a. Purse seine 385 fathoms long and 650 meshes deep with 3½" mesh in the upper two strips and the remainder 4½" mesh.

b. Twelve shackles of gill net.

c. A small purse seine 150 fathoms long and 200 meshes deep for fishing in areas too shallow for the large seines.

d. Salmon long-lines as used by the Danish fishermen in the Baltic Sea.

2. **Fish Handling Gear.**

Each boat was equipped with a special brailer to which canvas buckets attach, holding 110 gallons of sea water. Frames for supporting buckets were set along the starboard gunwale and hoses were provided for supplying the buckets with sea water.

The *Renown* had a plywood deck tank holding 1,100 gallons, and the *California Rose* had a vertical tank set in her hold of about 1,300 gallon capacity. Tanks were supplied with sea water by 4-inch pipes. Fish were either brailed into the main tanks or held in buckets depending upon size of catches. In either case, they were brought aboard from the seine without even leaving the water. It

TABLE 5. Summary of catches taken by the vessel *Tordenskjold*, May to Sept., 1956.

Date	Location		Surface Temp.	Salmon Catch							
	Lat. N.	Long.	°F.	Red	Chum	King	Silver	Pink	Total	Albacore	Steelhead
May 25	58° 00′	150° 00′ W	40.6°	2	1				3		
31	53 00	165 00 W	39.6	39	34	2			75		
June 7	55 00	165 00 W	37.6	62	17				79		
8	56 00	165 00 W	36.7	2	14	1			17		
9	57 00	165 00 W	34.3	2	14				16		
10	57 17	159 15 W	32.9		1				1		
10	57 00	160 00 W	32.2 Set 36.9 Haul	3	1	1			5		
13	58 00	165 00 W	36.0	2	45			4	51		
14	59 00	165 00 W	35.4	1	126	1		3	131		
16	60 00	170 00 W	34.3	1	19			2	22		
17	59 00	170 00 W	36.0	1	57			5	63		
18	58 00	170 00 W	38.8	1	31	1		5	38		
20	56 00	170 00 W	42.3	917	62	3		5	987		
21	55 00	170 00 W	44.6	679	67	1		9	756		
25	54 00	170 00 W	45.0	83					102		
July 29	54 00	170 00 W	46.6	1	2		1	1	5		
30	55 00	170 00 W	46.8	1					1		
31	56 00	170 00 W	46.2	1	9				10		
Aug. 1	58 00	170 00 W	44.1	4	6				9		
3	59 00	170 00 W	44.4		31		1		32		
4	60 00	170 00 W	45.9		6	1	1		8		
5	59 03	167 30 W	44.8	2	11			1	14		
6	59 00	165 00 W	44.4		4				4		
7	58 00	165 00 W	47.1	1	11				12		
8	58 00	162 30 W	46.8								
9	58 00	160 00 W	53.2	1	1	8	6		16		
11	57 00	160 00 W	47.8	2		1	1		4		
12	57 00	162 30 W	50.5		1				1		
13	57 00	165 00 W	50.9	1	3	2	1		7		
14	56 00	165 00 W	51.1	11	6		3		20		
Sept. 12	54 00	169 00 W	44.4								
14	55 00	170 00 W	46.9	1	12				13		
15	55 58	170 01 W	45.6			1			1		
16	57 00	170 00 W	44.1								
17	58 01	169 58 W	43.5	1					1		
19	57 00	165 00 W	40.3								
21	55 01	165 04 W	44.7								
TOTALS				1,822	610	23	14	35	2,504		

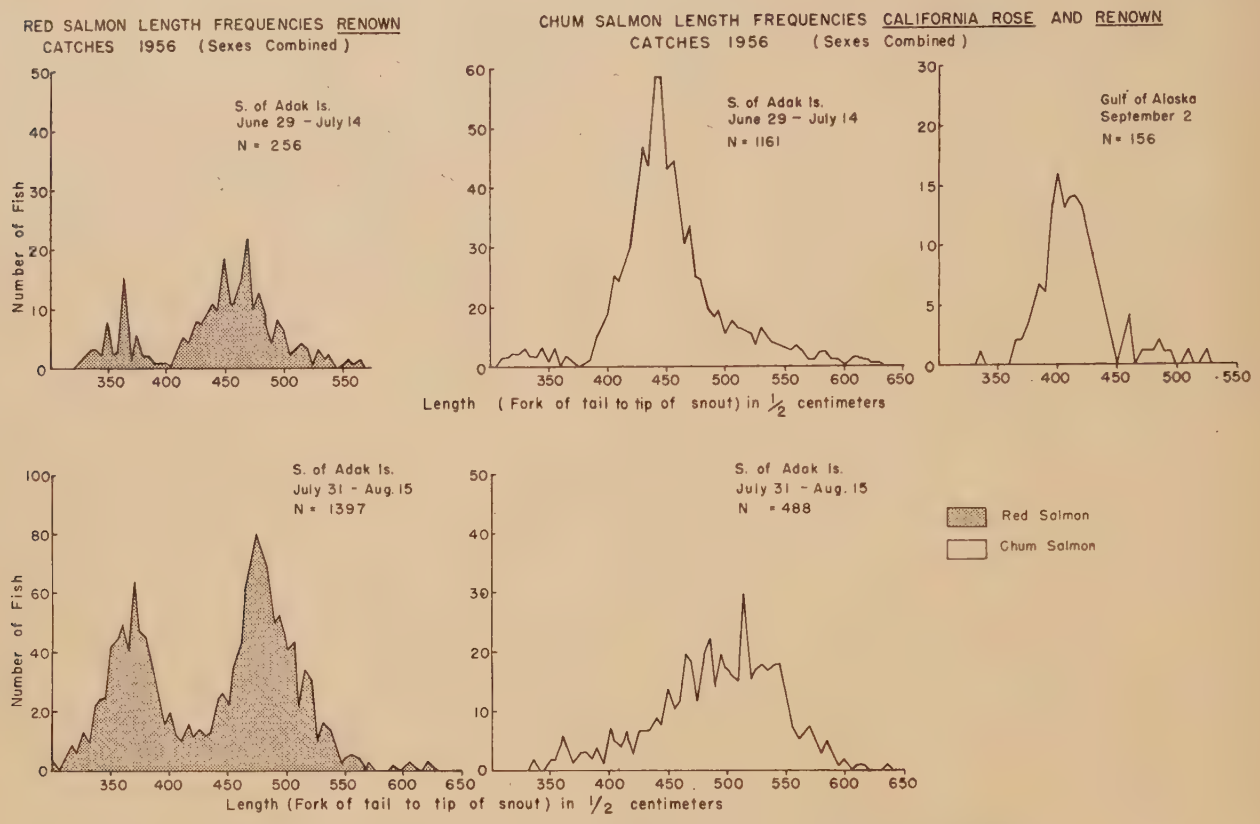
RED SALMON LENGTH FREQUENCIES RENOWN CATCHES 1956 (Sexes Combined)
S. of Adak Is. June 29 – July 14 N = 256
CHUM SALMON LENGTH FREQUENCIES CALIFORNIA ROSE AND RENOWN CATCHES 1956 (Sexes Combined)
S. of Adak Is. June 29 – July 14 N = 1161
Gulf of Alaska September 2 N = 156
Number of Fish
Length (Fork of tail to tip of snout) in 1/2 centimeters
S. of Adak Is. July 31 – Aug. 15 N = 1397
S. of Adak Is. July 31 – Aug. 15 N = 488
Red Salmon
Chum Salmon
Number of Fish
Length (Fork of tail to tip of snout) in 1/2 centimeters

Fig. 6. Length frequencies of salmon caught by the tagging vessels, 1956.

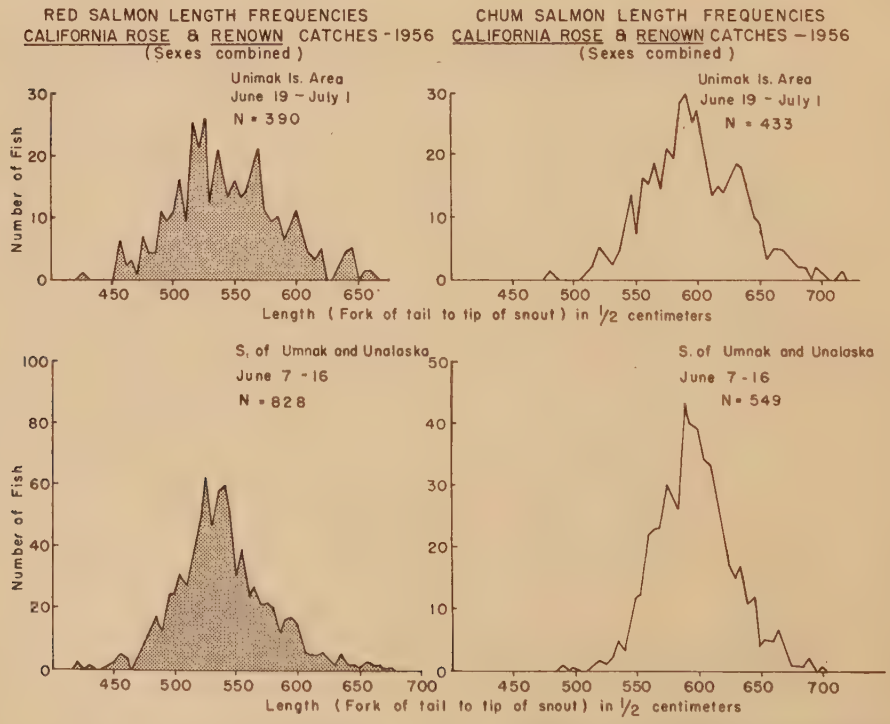
RED SALMON LENGTH FREQUENCIES CALIFORNIA ROSE & RENOWN CATCHES - 1956 (Sexes combined)
Unimak Is. Area June 19 – July 1 N = 390
CHUM SALMON LENGTH FREQUENCIES CALIFORNIA ROSE & RENOWN CATCHES – 1956 (Sexes combined)
Unimak Is. Area June 19 – July 1 N = 433
Number of Fish
Length (Fork of tail to tip of snout) in 1/2 centimeters
S. of Umnak and Unalaska June 7 - 16 N = 828
S. of Umnak and Unalaska June 7 - 16 N = 549
Number of Fish
Length (Fork of tail to tip of snout) in 1/2 centimeters

Fig. 7. Length frequencies of salmon caught by the tagging vessels, 1956.

was found that the tanks could hold 350 mature salmon with ease. The system worked very well, with the result that fish tagged were in much better condition than last year, when the continual chafing in the bunt of the seine was found to be injurious to the fish.

Two types of tagging boxes were used. One was designed to fit into the canvas bucket for underwater tagging, and the other was the standard padded box used last year. Small dip nets hung with ¼-inch knotless nylon were used for dipping fish from the tanks.

3. Fishing and Tagging.

A total of 8,783 salmon were caught, of which 7,371 were tagged. Table 14 following, lists the total tagged by date, location and species, and in addition shows the approximate breakdown of matures and immatures. Figure 5 shows the tagging locations of the minor experiments indicated by an "X" and of the experiments in which more than 100 were tagged, indicated by an "O."

Weather was a serious limiting factor during May in the Adak-Kiska Island areas. As a result very few salmon were taken and these mostly with

TABLE 6. Summary of catches taken by the vessel *Paragon*, July to September, 1956.

Date	Location		Surface Temp. °F.	Salmon Catch							
	Lat. N.	Long.		Red	Chum	King	Silver	Pink	Total	Albacore	Steelhead
July 12	59° 00′	140° 00′ W	52.9°	11	24			57	92		
13	59 00	145 00 W	54.3	12	137		2	20	171		
15	59 00	150 00 W	53.6	2				3	5		
20	55 00	155 00 W	50.7	45	91		6	33	175		10
21	54 00	155 00 W	50.9	44	44		4	8	100		3
22	53 00	155 00 W	50.9	13	8	1	1		23		2
23	52 00	155 00 W	49.3	26	19		1	5	51		1
24	51 00	155 00 W	48.9	37	10		4	1	52		2
25	50 00	155 00 W	49.2	3	29	1	6	1	40		
26	49 00	155 00 W	49.5	2	33		1		36		1
27	48 01	154 52 W	52.2	2	1				3		
28	46 56	155 00 W	54.3								
29	45 56	154 53 W	54.7								
31	45 39	160 03 W	57.7							8	
Aug. 1	47 00	160 00 W	54.1								
2	48 00	160 00 W	53.4		5				5		
3	49 00	160 00 W	52.3	2	27	1	3		33		
4	50 00	160 00 W	50.9	10	28				38		
5	51 00	160 00 W	50.7	6	32		1		39		
6	51 57	160 00 W	50.5	14	33				47		
7	53 02	160 00 W	50.7	23	10	1			34		2
8	54 00	160 00 W	53.8	21	80			3	104		
19	52 00	170 00 W	49.8	26	5				31		2
20	51 00	170 00 W	50.7	23	21				44		2
21	50 00	170 00 W	51.4	11	40	1			32		
22	49 00	170 00 W	53.6								
22	48 00	170 00 W	53.6								
25	46 00	170 00 W	53.6								
27	46 00	165 00 W	53.9								
28	47 00	165 00 W	53.6								
29	48 00	165 00 W	51.8							1	
30	49 00	165 00 W	50.5		7				7		
31	50 00	165 00 W	49.4	4	51				55		
Sept. 2	52 00	165 00 W	49.3	24	31				55		
3	53 00	165 00 W	48.7	14	17	1	2	2	36		7
7	53 00	165 00 W	50.4	2	4				6		
8	52 00	165 00 W	49.5	4					4		
10	51 00	165 00 W	50.7	5	16				21		
11	50 00	165 00 W	50.5	1	10				11		
12	49 00	165 00 W	51.8		20				20		
14	49 00	160 00 W	52.0		4				4		
15	49 00	155 00 W	53.8								
17	49 00	150 00 W	55.9								
22	49 00	135 00 W	59.6								
24	50 00	130 00 W	59.6								
TOTALS				387	837	6	31	131	1,394	9	32

the gill nets. After June 7, weather permitted more seining, and catches were successful enough that the gill nets were stored in the holds to leave the decks clear for seining.

A total of 46 were tagged from the gill nets, and 7,325 were tagged from the seines. The total number of seine hauls was 159—giving a catch of 8,613 salmon, or an average of 54.2 per haul. If prospecting hauls are eliminated, the remaining total of 94 hauls gave a catch of 8,041 salmon or 85.5 per haul. The usual method of fishing the seines was to make "tow" hauls with the net "held open" for about 30 minutes. In all cases the hauls were made "blind," since little or no evidence of fish was seen in the areas fished. As shown in Figure 5, most fishing was done within 15 miles of shore.

4. **Tags.**

Of the 7,371 tags affixed, 6,356 were of the soft white tube material, 990 were discs, and 25 were small diameter black tubes being tested on very small fish. However, for salmon as small as 300 mm., the standard 1/16-inch tubes appear satisfactory.

5. **Matures and Immatures.**

Table 14 lists the maturity of salmon according to fishing locations. It would be impossible to divide immatures from matures down to the last fish, but in general the catches were either predominantly

TABLE 7. Summary of catches taken by the vessel *Celtic*, July to August, 1956.

Date	Location		Surface Temp.	Salmon Catch							
	Lat. N.	Long.	°F.	Red	Chum	King	Silver	Pink	Total	Albacore	Steelhead
July 13	53° 00′	145° 00′ W	50.0°	13	101		2	12	128		2
14	52 00	145 00 W	51.0	9	42	1		3	55		3
16	51 00	145 00 W	51.0	6	33			3	42		3
17	50 00	145 00 W	51.8	8	99	1	14	2	124		1
18	49 00	145 00 W	52.3	1	26				27		1
19	48 00	145 00 W	54.1		4				4		
21	48 00	150 00 W	51.2	1	34		4		39		1
22	49 00	150 00 W	50.7	7	67	1	3		78		
23	50 00	150 00 W	50.5	5	80		3	1	89		3
24	51 00	150 00 W	50.3	22	57	1	3	3	86		3
25	52 00	150 00 W	50.3	9	32		5	3	49		1
26	53 00	150 00 W	50.2	17	27		3	10	57		1
31	59 00	145 00 W	57.0	5	44		4	53	106		
Aug. 1	58 00	145 00 W	55.5	6	25		7	48	86		2
2	57 00	145 00 W	55.0	4	46		1	46	97		4
3	56 00	145 00 W	55.0		51		4	15	70		2
4	55 00	145 00 W	53.0	3	27		2	1	33		5
5	54 00	145 00 W	52.0	15	27	2			44		1
7	54 00	150 00 W	52.5	31	64			1	96		2
8	55 00	150 00 W	54.0	13	27			6	46		3
9	56 00	150 00 W	55.0	10	9		1	12	32		3
10	57 00	150 00 W	55.0	7	19			10	36		1
11	58 00	150 00 W	50.1	9	10	3	7	72	103		
17	55 00	155 00 W	54.0	2	82				84		6
18	54 00	155 00 W	54.0	58	35		1		94		
19	53 00	155 00 W	54.0	110	40				150		3
20	52 48	154 44 W	43.0	45	3				48		4
21	52 00	155 00 W	52.0	34	12	1			47		2
22	51 00	155 00 W	52.0	36	39	1			76		2
23	50 00	155 00 W	52.0	18	33				51		
26	49 00	155 00 W	51.0	1	18				19		
30	48 00	150 00 W	54.0							2	
31	49 00	150 00 W	53.0								
Sept. 1	50 00	150 00 W	52.8		6				6		
2	51 00	150 00 W	52.0	3	30				33		
3	52 00	150 00 W	52.3	16	51				67		
4	53 00	150 00 W	52.3	44	45				89		3
12	53 00	145 00 W	54.5	2	12				14		1
13	52 00	145 00 W	55.6								1
14	51 00	145 00 W	56.5								
15	50 00	145 00 W	57.2								
17	52 00	140 00 W	57.7								
18	51 00	140 00 W	57.7								
19	50 00	140 00 W	57.6							3	
TOTALS				570	1,357	11	64	303	2,305	5	64

TABLE 8. Summary of catches taken by the vessel *John N. Cobb*, July to August, 1956.

Date	Location		Surface Temp. °F.	Salmon Catch						Albacore	Steelhead
	Lat. N.	Long.		Red	Chum	King	Silver	Pink	Total		
July 18	46° 17′	126° 57′ W	60.5°								
19	45 05	126 54 W	62.1								
21	46 45	130 47 W	59.0							2	
23	50 01	133 58 W	56.0	2							1
24	50 00	137 00 W	55.0	2			1				
25	50 00	140 00 W	54.0	1							
26	48 40	140 00 W	54.0								
27	47 20	140 00 W	55.5							7	
28	46 00	140 00 W	58.0							2	
30	46 00	133 30 W	58.0							9	
Aug. 1	46 00	127 28 W	61.0								
2	45 58	125 49 W	61.0								
7	46 12	125 13 W	62.5								
9	41 50	126 24 W	61.0								
15	45 00	135 00 W	63.0							3	
17	45 00	140 00 W	62.2								
19	46 00	145 00 W	59.0								
20	47 00	145 00 W	57.3								
21	48 00	145 00 W	56.5								
22	50 00	145 00 W	56.5								
23	49 59	141 48 W	58.2				1				
24	49 58	139 00 W	58.5								
25	49 00	137 00 W	59.0							1	
26	48 06	135 10 W	61.5								
27	49 06	133 11 W	61.0								
28	50 01	131 31 W	61.7								
29	50 00	129 30 W	61.5								
TOTALS				5			2			25	1

TABLE 9. Summary of catches by vessels of Pacific Oceanic Fishery Investigations north of 40°N. Latitude, 1956.

Vessel	Date	Location		Surface Temp. °F.	Catch	
		Lat. N.	Long.		Salmon	Albacore
Charles H. Gilbert	Apr. 23	41° 28′	165° 18′ W	50.0°	3 (Pink)	
	24	41 30	164 33 W	50.7	1 (Pink)	
John R. Manning	July 25	43 02	174 57 W	60.8		32
	26	43 07	174 52 W	62.6		91
	27	43 10	174 53 W	61.5		38
	28	43 56	174 57 W	60.0		18
	29	43 38	174 51 W	60.1		2
	30	43 46	174 35 W	60.1		1
	31	44 48	174 46 W	59.1		86
	Aug. 1	44 54	174 08 W	59.0		24
	2	44 54	174 29 W	64.9		25
	3	46 01	174 58 W	63.9		12
	4	47 01	175 00 W	57.7		
	5	47 58	175 00 W	59.7		
	6	48 59	175 00 W	55.8	4	
	16	45 57	171 44 W	59.2		10
	19	46 28	166 54 W	55.7		27
	21	46 00	160 16 W	53.2	1	52
	22	46 03	160 16 W	53.8		65
	26	46 27	154 56 W	53.9		13
	28	45 59	150 00 W	56.5		1
	30	47 04	145 03 W	57.0		
	31	45 59	145 02 W	58.3		
	Sept. 1	44 57	145 01 W	60.3		3
	2	43 58	144 58 W	62.2		
TOTALS					9	500

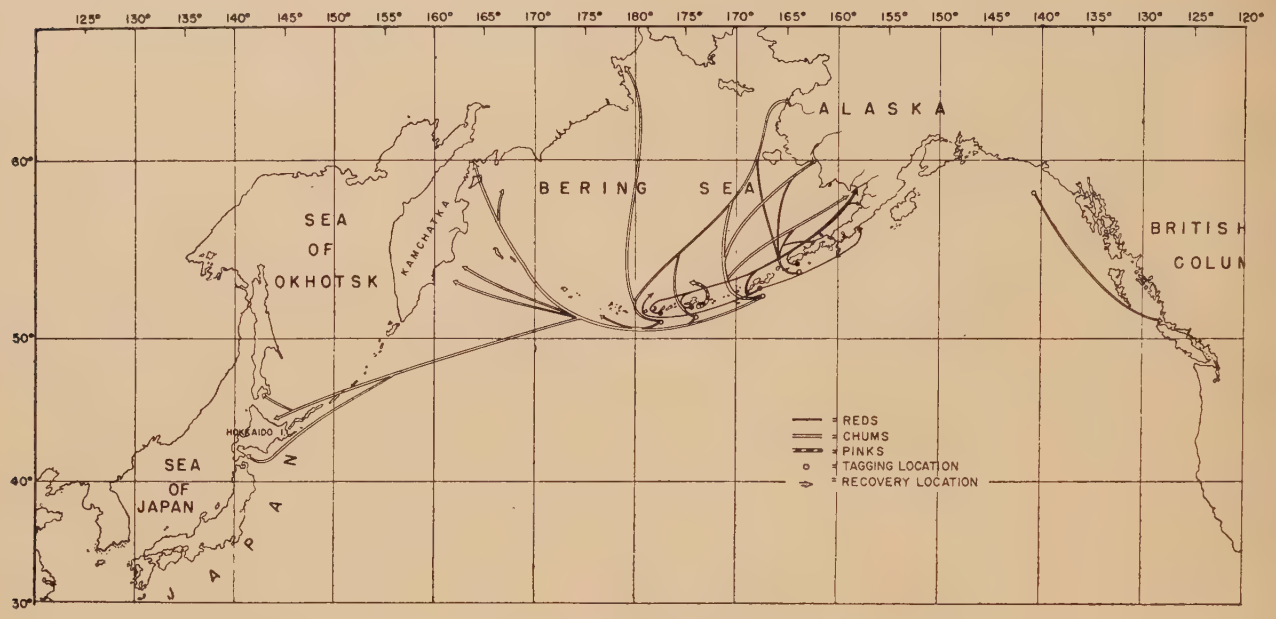

Fig. 8. Recovery pattern as of November 1, 1956, for 1956 tagging.

TABLE 10. List of morphological characters used in distance function analysis.

Red Salmon	Chum Salmon
1. Number of scales on the lateral line.	1. Number of scales on the lateral line.
2. Number of branchiostegal rays.	2. Number of branchiostegal rays.
3. Number of pectoral fin rays.	3. Number of pectoral fin rays.
4. Number of anal fin rays.	4. Number of dorsal fin rays.
5. Total number of gill rakers.	5. Number of ventral gill rakers.
6. Position of the first haemal arch.	6. Number of caudal vertebrae.
7. Number of circuli on the scale in the first year of growth.	7. Number of circuli on the scale in the first year of growth.

TABLE 11. Probability of correct classification between samples of red salmon from various North American areas and those from the Japanese high seas fisheries.

District	Probability of correct classification in per cent. 60 - 70	70 - 80	80 - 90	90 - 100
Attu	x			
Alaska Peninsula		x		
Bristol Bay			x	
Kodiak		x		
Cook Inlet		x		
Copper River		x		
Petersburg (Southeastern Alaska)		x		
Ketchikan (Southeastern Alaska)			x	
Nass River	x			
Skeena River		x		
Rivers Inlet		x		
Fraser River				x
Columbia River			x	

TABLE 12. Probability of correct classification between samples of chum salmon from various North American areas (and the Japanese North Pacific fishery) and samples from the Okhotsk Sea.

District	Probability of correct classification in per cent. 60 - 70	70 - 80	80 - 90	90 - 100
Japanese North Pacific Fishery			x	
Alaska Peninsula		x		
Petersburg (Southeastern Alaska)	x			
Ketchikan (Southeastern Alaska)			x	
Namu (British Columbia)				x
Fraser River			x	

TABLE 13. Numbers of whole salmon collected for North Pacific racial studies in 1955 and 1956.†

	1955				1956			
	Sockeye	Chums	Pinks	Total	Sockeye	Chums	Pinks	Total
Aleutian Islands								
Attu	52	—	67	119	396	3	208	607
Adak	13	—	—	13	277	2	287	566
Unalaska	5	—	90	95	191	4	437	632
Alaska Peninsula								
King Cove	117	140	130	387	225	200	200	625
Chignik	50	—	—	50	125	—	—	125
Bristol Bay								
Ugashik	100	—	—	100	220	—	—	220
Egegik	100	—	—	100	220	—	—	220
Naknek	50	—	—	50	220	—	—	220
Kvichak	100	—	—	100	199	128	14	341
Nushagak	15	—	—	15	220	—	—	220
Northern								
Kuskokwim	3	10	—	13	30	104	—	134
Yukon	1	18	1	20	—	100	9	109
North of Yukon	4	45	11	60	47	271	110	428
Cook Inlet								
Seldovia	100	50	50	200	—	125	125	250
Anchorage	100	25	—	125	220	—	—	220
Kodiak Island								
Karluk	250	—	—	200	425	—	125	550
Red. R.	60	—	50	160	230	—	—	230
Alitak	50	—	50	100				
Prince William Sound								
Copper R.	200	—	—	200	220	—	—	220
Yakutat								
Pelican	—	—	—	—	225	125	125	475
Southeast Alaska								
Pelican	—	—	—	—	—	100	—	100
	125	225	225	575	225	250	125	600
Ketchikan	150	160	154	464	225	247	145	617
British Columbia								
Northern	150	50	125	325	324*	210*	210*	744*
Central	114	60	10	184	225*	175	175	575*
Southern	320	—	279	801	225*	*	*	225*
Washington and Oregon								
Puget Sound	—	48	100	148	27	135	—	162
Columbia R.	75	—	—	75	472	35	—	507
Japan Proper								
Local Streams	—	—	—	—	—	50	50	100
Japanese Motherships								
Okhotsk Sea	125	100	125	350	632	315	315	1,262 (Est.)
N. Pacific Ocean	399	425	385	1,209	1,264	630	630	2,524 (Est.)
Japanese Res. Vessels	—	—	—	—	116*	148*	119*	383*
U.S. Research Vessels	459	1,619	720	2,798	3,468	3,718	465	7,651
	3,287	3,177	2,572	9,036	10,893	7,075	3,874	21,842

† In 1955 a total of 9,375 whole salmon, including silvers and kings, were collected. In 1956 the estimated total will approach 24,000 salmon. Incomplete 1956 collections are marked with an asterisk (*).

Morphometric measurements and scale samples were taken in 1955 from an additional 43,765 salmon. Similar numbers of measurements and scales are being taken in 1956, greatly augmented by the Fisheries Research Institute, U. of W., collections.

mature or immature. Gonad measurements were made on the salmon saved for examination, and it appears there is little or no overlap between those of matures and immatures.

The above applies principally to reds and chums. Pinks and cohos, of course, were all mature except for a few cohos tagged off Vancouver Island. Kings were mostly immature with an occasional mature fish. Steelhead were all immature.

The length-frequency data in Figures 6 and 7 show the sizes of reds and chums taken in the principal areas fished. Field examination of scales showed the smaller mode of reds to be one sea-check fish and the larger mode two checks. Chum scales showed one check for the smaller mode and two checks for the larger mode (Figure 6) and in addition, some 3 and 4 check fish are at the extreme right. The chum sample from the Gulf of Alaska was mainly one check fish with a few two checks on the far right of the curve.

In Figure 7, the mature reds and chums are shown. Here the size differences between the various ages is obscured due to lumping of the sexes.

The best estimate of the relative numbers of matures and immatures tagged during 1956 is:

	Red	Chum	Pink	Coho	King	Steelhead	Total
Matures	1,831	1,357	239	41	5	—	3,473
Immatures	1,572	2,280	—	6	35	5	3,898
Total	3,403	3,637	239	47	40	5	7,371

TABLE 14. Summary of tagging by general area—1956.

Inclusive Dates	Area	Red	Chum	Pink	Silver	King	Steelhead	Total	Maturity
5/2 to 5/30	Adak - Kiska Is.	19	24	2		4		49	matures & immatures
6/29 to 8/15	Adak Is. area	1,546	1,585	14	6	12		3,163	* immatures
6/23 to 6/28	Amlia - Atka Is.	69	710	11				790	* immatures
8/15	Amlia - Atka Is.		31					31	immatures
6/7 to 6/28	Umnak - Unalaska Is.	1,395	609	67		2		2,073	matures
8/13	Umnak - Unalaska Is.		7			2		9	immatures
6/19 to 7/1	Unimak - Sanak Is.	372	473	52				897	matures
8/22 to 8/30	Kodiak - Shumagin Is.	1	20			13		34	matures
9/1 to 9/3	Gulf of Alaska		148			5	2	155	immatures
9/7 to 9/14	S.E. Alaska & B.C.	1	30	93	41	2	3	170	matures
TOTALS		3,403	3,637	239	47	40	5	7,371	

* Few matures.

TABLE 15. Tag returns, 1956. (As of February 12, 1957.)

	Red	Chum	Pink	Coho	King	Steelhead	Total
Total Tagged	3,403	3,637	239	47	40	5	7,371
Immatures	1,572	2,280	—	6	35	5	3,898
Matures	1,831	1,357	239	41	5	—	3,473
Total Returns	99	57	1	4	—	—	161
Per cent. Returns*	5.4	4.2	0.4	9.8	—	—	4.6
Returns in American Fishery or Streams	98	35	—	4	—	—	137
Per cent. in American Fishery or Streams*	5.3	2.6	—	9.8	—	—	3.9
Returns in Aleutian Fishery	1	1	1	—	—	—	3
Per cent. in Aleutian Fishery*	0.05	0.07	0.4	—	—	—	0.09
Returns in Asian Fishery or Streams	—	21	—	—	—	—	21
Per cent. in Asian Fishery or Streams*	—	1.5	—	—	—	—	0.6

* Per cent. returns based on number of matures tagged.

6. **Tag Recoveries.**

Table 15 presents the tag returns as of February 12, 1957, broken down by species. Note that the percentage returns are based on the numbers of matures tagged.

The 4.6 per cent. return compares with a 13.6 per cent. return from the 1955 tagging. However, the 1956 tagging was done farther from the commercial fishing areas than in 1955, and also the 1956 fish were about half immatures, therefore not expected to be taken until 1957 or possibly 1958. Thus, if 40 per cent. is considered an average return for tagging experiments within commercial fishing areas, the figure drops sharply (13 per cent.) when tagging is done only a few miles outside, as in 1955, and drops again (4.6 per cent.) as tagging is done even farther away, as in 1956.

Figure 8 shows the recovery pattern for salmon tagged in 1956. The distribution of recoveries is extremely interesting and revealing since it is the first time that high seas tagging has been accomplished in such a manner and on a large enough scale to produce an appreciable number of recoveries. However, the picture is far from complete because about half of the salmon tagged were immature and thus not expected to be recovered until 1957 and possibly 1958.

7. **Tag Return Poster.**

Tag return posters for use in Alaska, Washington and Oregon, were revised for 1956 and issued in a new color and waterproofed for longer life. Postage-free tag return envelopes were printed and distributed together with letters outlining the 1956 operations. Canadian, Japanese, and Russian authorities arranged for recovery of tags in their territories.

8. **Tag Returns from 1955 Experiments.**

Table 16 shows the latest figures on tag returns broken down by species, gear, type of tag, and location. In the seven months since the last report, six tags have been received. These six tags, which had been out for one year or more, represent 2.14 per cent. of the total (280) tags placed on fish in the

TABLE 16. Returns from 1955 tagging experiment (as of September 26, 1956). *Memento* and *Starling* (tagged June and July, 1955).

	Red	Chum	Pink	Silver	King	Total
By Species and Gear						
Purse Seine:						
Tagged	117	121	372	230	211	1,051
Recovered	31	5	50	35	27	158
Percentage recovered	26.5	4.1	16.1	15.2	12.8	15.0
Gill Net:						
Tagged	181	55	85	1	1	323
Recovered	16	4	8	—	—	28
Percentage recovered	8.8	7.3	9.4	—	—	8.7
Total:						
Tagged	298	176	457	232†	215‡	1,378§
Recovered	47	9	68	35	28	187
Percentage recovered	15.8	5.1	14.7	15.1	13.0	13.6*

	Tagged	Recovered	Per cent. Recovered
By Type of Tag			
Disc	604	86	14.2
Plastic Tube	775	101	13.0
By Location of Tagging			
Swiftsure - Umatilla Area	280	43	15.4
Queen Charlotte Sound	208	42	20.2
Dixon Entrance	22	4	18.2
Coronation Island to Cape Spencer	168	30	17.9
Fairweather Ground	18	2	11.1
Kodiak Island Area	682	66	9.7

† Includes one troll-caught coho (not recovered).

‡ Includes three troll-caught kings (one recovered).

§ Not including one steelhead tagged.

* Thirteen additional tagged salmon reported through Red River weir (Kodiak Island) and one tagged red reported by the survey crew in a Cook Inlet stream are not included here, although they probably belong to this experiment.

Umatilla-Swiftsure area. They were returned from Georgia Straits, the west coast of Vancouver Island, and as far south as Heceta Head on the Oregon coast, and all were taken from troll-caught king salmon.

Of the 103 salmon taken by trolling and tagged aboard the *John N. Cobb* in May of 1955 in the Swiftsure vicinity, a total of 17 have been returned, or 16.5 per cent. Of this total, three tags (or 2.91 per cent) had been at sea for one year or more.

Of the 331 salmon taken by gill nets and tagged aboard the *John N. Cobb* in June, July, August and September, 1955, in the Gulf of Alaska and westward, no new recoveries have been received, leaving the total recovery at 3 or 0.9 per cent. as given in the last report.

Oceanography.

Exploration of the sea and the systematic surveys that are essential to the understanding of the distribution, abundance and migration of economically important fishes are arduous and expensive and must be carried out on a year-round basis if their true characteristics are to be understood. The value of such information lies in our ability to relate direct observations of the fishes to a background of information that may be called the "geography" of the oceans. This geography is made up of a vast number of physical and chemical features that themselves directly affect the fishes or, what is more important, influence the type and abundance of food organisms available to the fish. Their geography is not directly related to latitude and longitude because the pattern of conditions is varying, changing with the seasons and differing from year to year. It is through a knowledge of such processes that the real value of oceanography will develop, that is, through an ability to predict how conditions will change with time and how these changes may affect the distribution and movements of the fish or what will be "good" years or "bad" years that may control the abundance or growth of the fish.

The oceanographic studies undertaken have been directed along two main lines: first to determine the conditions existing in areas where exploratory fishing operations are being conducted so that some insight can be gained into the environmental factors that may be related to salmon. This program has involved placing oceanographers and the necessary equipment on board the exploratory fishing vessels. Because the availability of food may be the most direct factor affecting the salmon on the high seas, particular emphasis has been placed on this phase of the program. However, very little is known about the feeding habits of the salmon while in the open ocean and hence one of the aspects of the work has been to study the stomach contents of the fish in order to learn what types of food are consumed.

The areas covered by the exploratory fishing vessels are limited and the types of investigation that can be made from them are hampered by many limitations. Consequently, it is essential as a part of the program, to make surveys that are primarily for oceanographic investigations. For this purpose the *R.V. Brown Bear* of the University of Washington has been used. Limitations of funds has greatly restricted the specialized types of studies that should be made but fortunately a large share of the cost of operations is borne by other agencies. The Pacific Ocean is tremendous and a single vessel cannot cover more than a small portion of it. Fortunately, both Japan and Canada have been able to support far more intensive programs in oceanography and the data collected by the United States, when added to that of Japan and Canada, should provide a basis for understanding the general environmental conditions in the Northern Pacific.

During the summer of 1955 oceanographers accompanied the *John N. Cobb* and the *Mitkof* and *Paragon* during their exploratory fishing operations that are described elsewhere in this report. The results obtained on these vessels were limited by lack of equipment and the rather limited areas and times of the surveys. However, they provided the first information on the relationships between the salmon and their environment procured by U.S. investigations and in general confirmed the earlier findings of the Japanese. Probably the most significant results were: (a) the wide distribution of salmon in the Gulf of Alaska and (b) the apparent boundary to the southern extent of the salmon located at about 50°N. except near the American Continent and south of the Aleutian Islands where it extended further south.

From the experience gained in 1955 and because of funds made available in the fall of that year, it was possible to procure the necessary equipment, improve

the devices for the collection of food organisms and to plan for a more definitive series of surveys for the 1956 season. Oceanographers and equipment were placed on board the *Mitkof, Tordenskjold, Paragon* and *Celtic* whose operations are described elsewhere. The fishing operations of these vessels were planned with the general oceanographic conditions and the experience of 1955 in mind. Because of the significance of the temperature condition it was believed that the southern boundary of the salmon would be found to move northward during the late spring and summer months. Incomplete reports from the exploratory fishing vessels confirmed this prediction.

Because only a very small number of stomachs were collected during the 1955 season specifically for food studies, particular efforts have been made to examine samples made available from the fish collected for morphometric analyses being made by the U.S. Fish and Wildlife Service. Several hundred stomachs from each of three species, namely: sockeye, chum and pink salmon, have been examined. Preliminary reports on the sockeye and chum salmon have been issued based on Japanese and American caught fish collected during 1955. These studies have shown that the bulk of the food is seasonal in nature in a form that is present only during the summer months. Although a variety of invertebrate forms are represented, a large number of the stomachs contain essentially pure catches of such animals as Copepods, Amphipods and Euphausids. Because these and other forms, including some of the fishes, are known to migrate upwards at dusk and swarm in the surface layers, it is believed that the salmon feed actively during the hours of darkness and it is during this feeding activity that they are caught in the gill nets. With this theory in mind, the *Brown Bear* has conducted a number of tests to determine the day to night variation in the abundance of food organisms near the surface and has tested a number of different types of nets, in order to develop a method of sampling that will most closely measure the abundance of salmon food. From such studies it is believed that techniques can be devised to sample the food organisms and that this will provide means for locating the best feeding grounds that should support the larger concentration of salmon.

The general pattern of currents affects the distribution of temperature and other properties, controls the fertility of the ocean water and may directly affect the movements of the salmon. To investigate these and other problems, the *Brown Bear* has made three cruises during the past year that provided data being analyzed under the program. During July - September, 1955, the *Brown Bear* participated in Operation NORPAC, a co-operative survey of the waters north of 20°N. that was carried out jointly by Japanese, Canadian and U.S. oceanographic vessels. The data, now being assembled in an atlas-like publication, will provide the first systematic series of observations from such a large portion of the ocean, and will provide the basis for further detailed investigations such as those planned for the International Geophysical year, 1957-58.

In order to obtain data early in the year, the *Brown Bear* conducted a survey of the Gulf of Alaska and adjacent waters during the period May 1 to June 9, 1956. This survey revealed the existence of a large area of cold water to the south of Kodiak that had been indicated by surveys made in the summers of 1954 and 1955. The origin of this body of cold water is still not known but it apparently persists for a long period as relatively cool water was found in the same general area late in the summer, despite the fact that the waters nearer the American Continent were warmer than usual. The significance of this feature in the distribution of the salmon will be established when the catch statistics have been analyzed.

During the period July 16 to August 31, 1956, the *Brown Bear* conducted a joint survey with the *John N. Cobb* off the coast of British Columbia, Washington and Oregon and extending westward about 500 miles. This program, part of an international survey sponsored by the Albacore Steering Committee, will be of great value because of the simultaneous surveys conducted by Canada and other U.S. Agencies. A few salmon were taken at 50°N. during the latter part of July but associated with the progressive warming of the water, no salmon were caught in the same area when it was re-visited late in August, although commercial fishing was active in the colder coastal waters. The distribution and movements of salmon, both of young seaward migrants and of returning adults must obviously be affected by the currents and water conditions near the American Continent; because these waters are readily accessible to investigation they should be

studied in detail in order to establish relationships that can be applied to other more remote areas.

KING CRAB INVESTIGATION

1956 Field Work:

During the summer of 1956, two cruises were planned with the chartered vessel *Tordenskjold* to the king crab *(Paralithodes camtschatica)* grounds in the eastern Bering Sea. The trips were each of about two weeks duration, to take place in the latter part of July and the latter part of August. The area covered and the station pattern are the same as those employed in 1955. Essentially, it is designed to cover the area which is utilized by the United States and Japanese crab fishery in the eastern Bering Sea.

The field work was undertaken for the purposes of releasing tagged crabs, determining the distribution on the grounds, observing the condition of the crabs with respect to the moulting cycle, and determining the damage to female and undersized crabs as the result of otter trawling.

Approximately 3,000 crabs were tagged with a plastic "spaghetti" tag, and an additional 1,100 were tagged with Peterson disc tags. Preliminary analysis of the returns from the 1954 and 1955 taggings indicate a lower rate of return for the "spaghetti" tags, and comparable distribution of the two types will enable us to determine whether or not the discrepancy is caused by the tag itself.

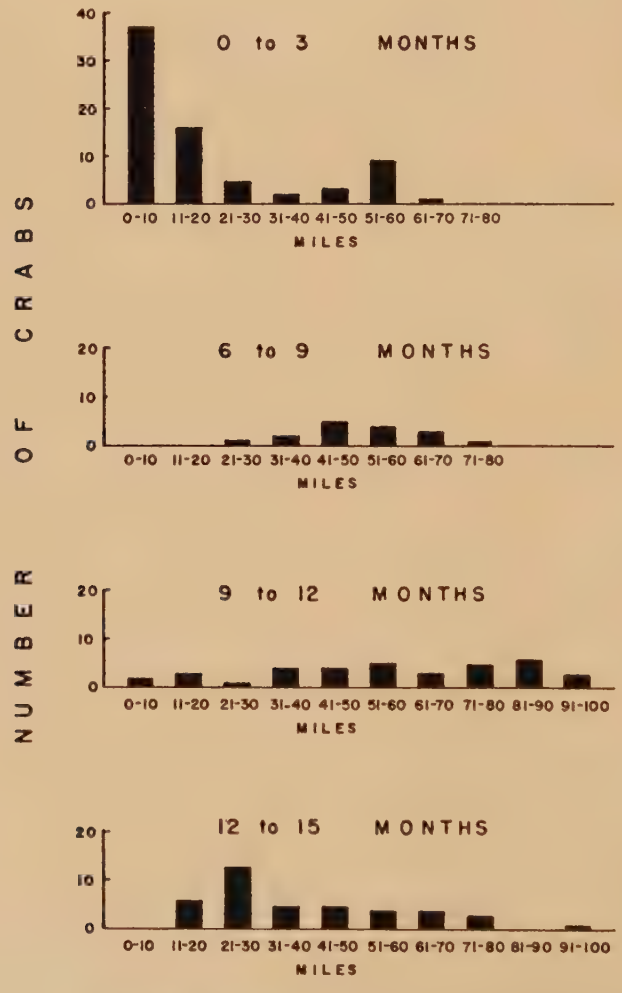

Fig. 9. Migration distances of tagged crabs for various periods of freedom.

For each station the number, size, sex, shell condition and injuries of each crab were noted.

Preliminary Analysis of Tagging Results.

As shown in Table 17, tagging studies on king crab were begun in the Bering Sea in 1954 and were continued in 1955 and 1956. In 1954 tagging was done from the commercial vessels with Peterson disc tags, and in 1955 and 1956 from a chartered vessel using chiefly plastic "spaghetti" tags. The Peterson tag could not possibly have remained on the crabs through moulting, but it was believed that the "spaghetti" tags would. Five of the crabs tagged with "spaghetti" tags in 1955 have shown growth, but sufficient data are not available to permit conclusions concerning growth rates.

From the 1954 tagging with Peterson tags, it is evident that all of the male crabs do not shed their shells annually.

A preliminary analysis of the movements of tagged crabs appears to show that there is mixing of crabs throughout the area now utilized by the fishery. Figure 9 indicates (1) that movements of from 50 to 100 miles are not uncommon and (2) that crabs released on the stations furthest from the fishery (1955 releases recovered in 1956) were well represented in the fishery.

The figures 10-13 showing migration are schematic in nature and are not intended to show actual routes. For more ready understanding, stations from which fewer than three recoveries were made have been omitted. This eliminates much of the data, but the general pattern is clarified and appears essentially the same. This could be expected, since the recovery locations are largely the spots at which the fishery was concentrated. Therefore, until adjustments for the localized nature of the fishery and of the distribution of tag releases have been made, it must be borne in mind that the actual migratory pattern may be quite different than that shown. If migrations to the northwest occurred, little chance of recovery existed because of the modest fishery in that area.

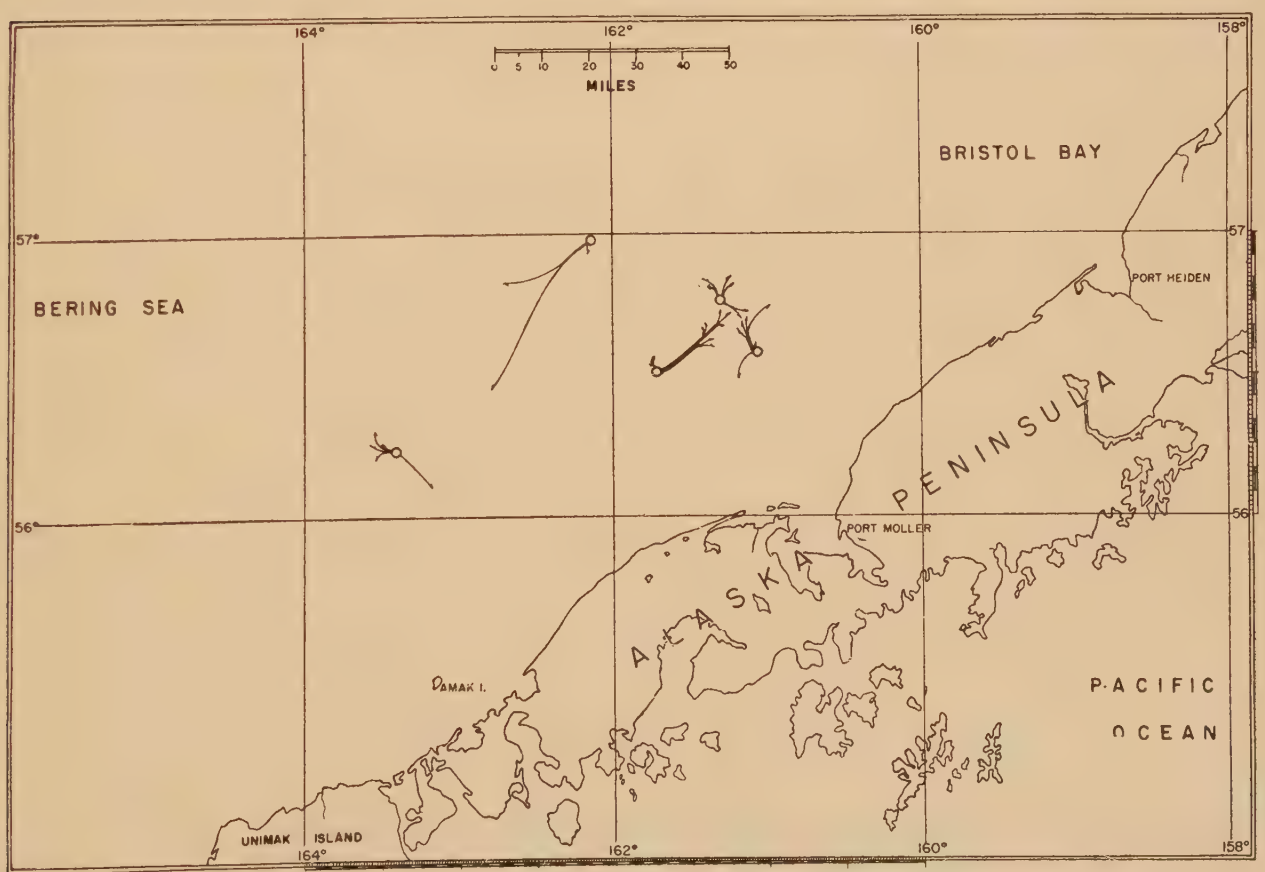

Fig. 10. Migration of tagged king crabs in the Bering Sea; tagged in 1954 and recovered in 1954.

TABLE 17. Bering Sea king crab tagging.

Year	Number tagged	1954 recoveries	1955 recoveries	1956 recoveries	Total
1954	1,108	44	60	1	105
1955	1,350		32	53	85
1956	4,063			54	54

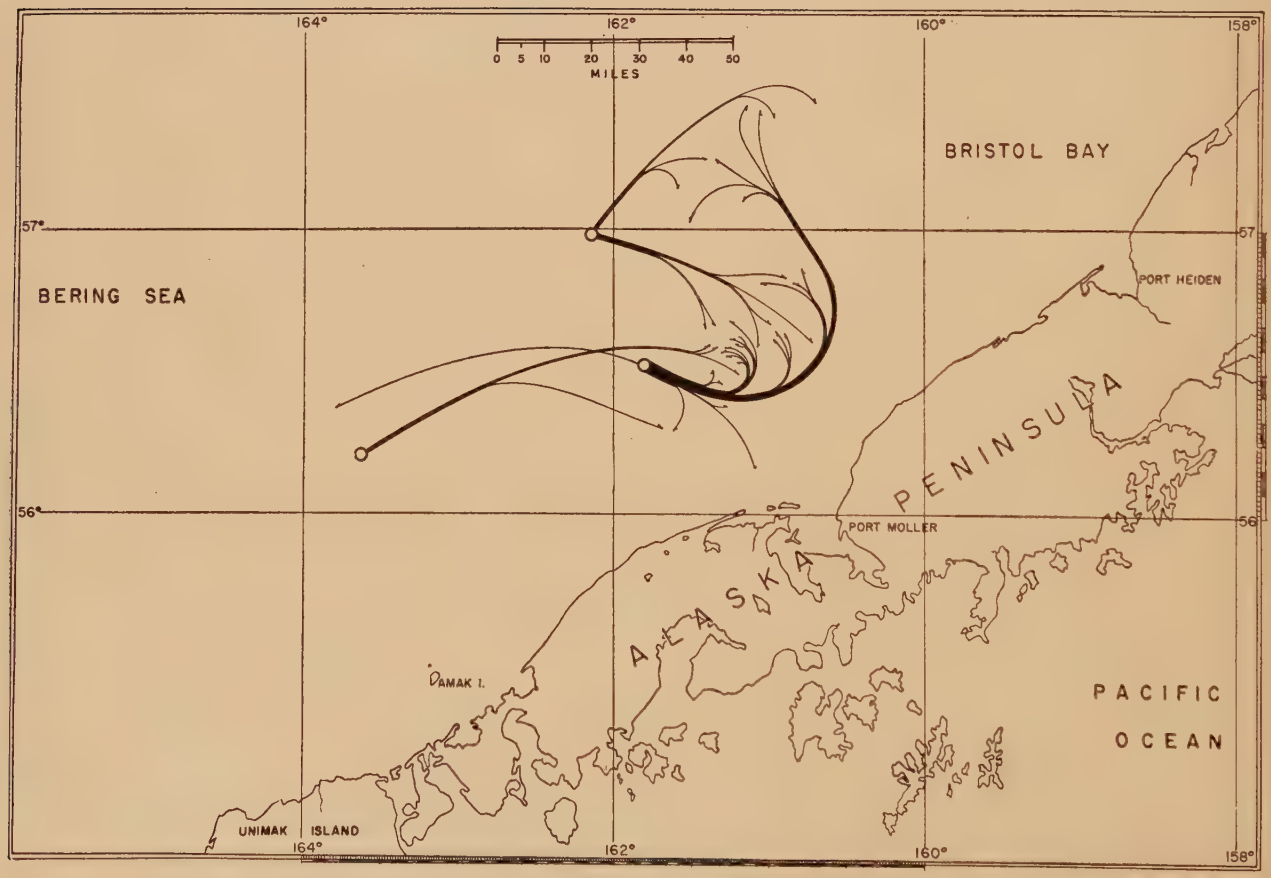

Fig. 11. Migration of tagged king crabs in the Bering Sea; tagged in 1954 and recovered in 1955.

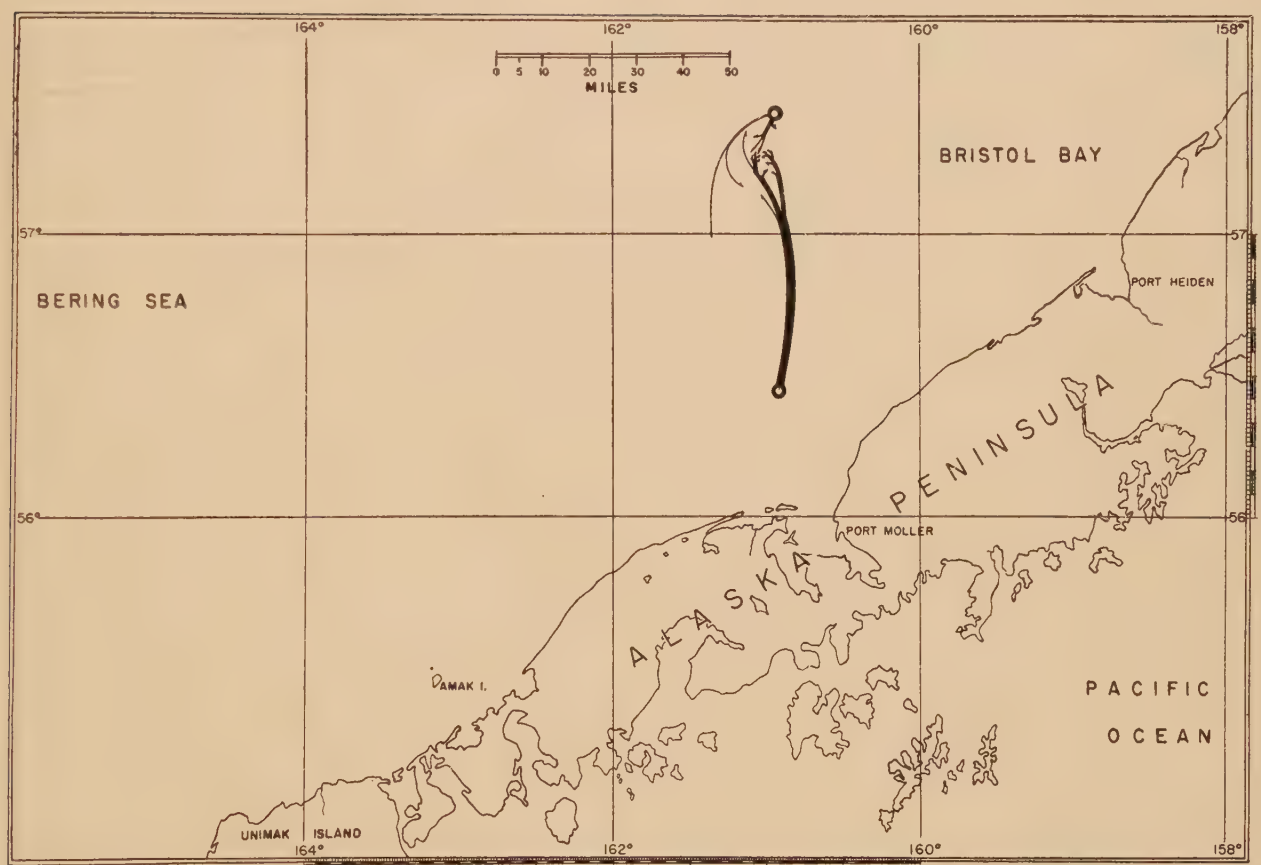

Fig. 12. Migration of tagged king crabs in the Bering Sea; tagged in 1955 and recovered in 1955.

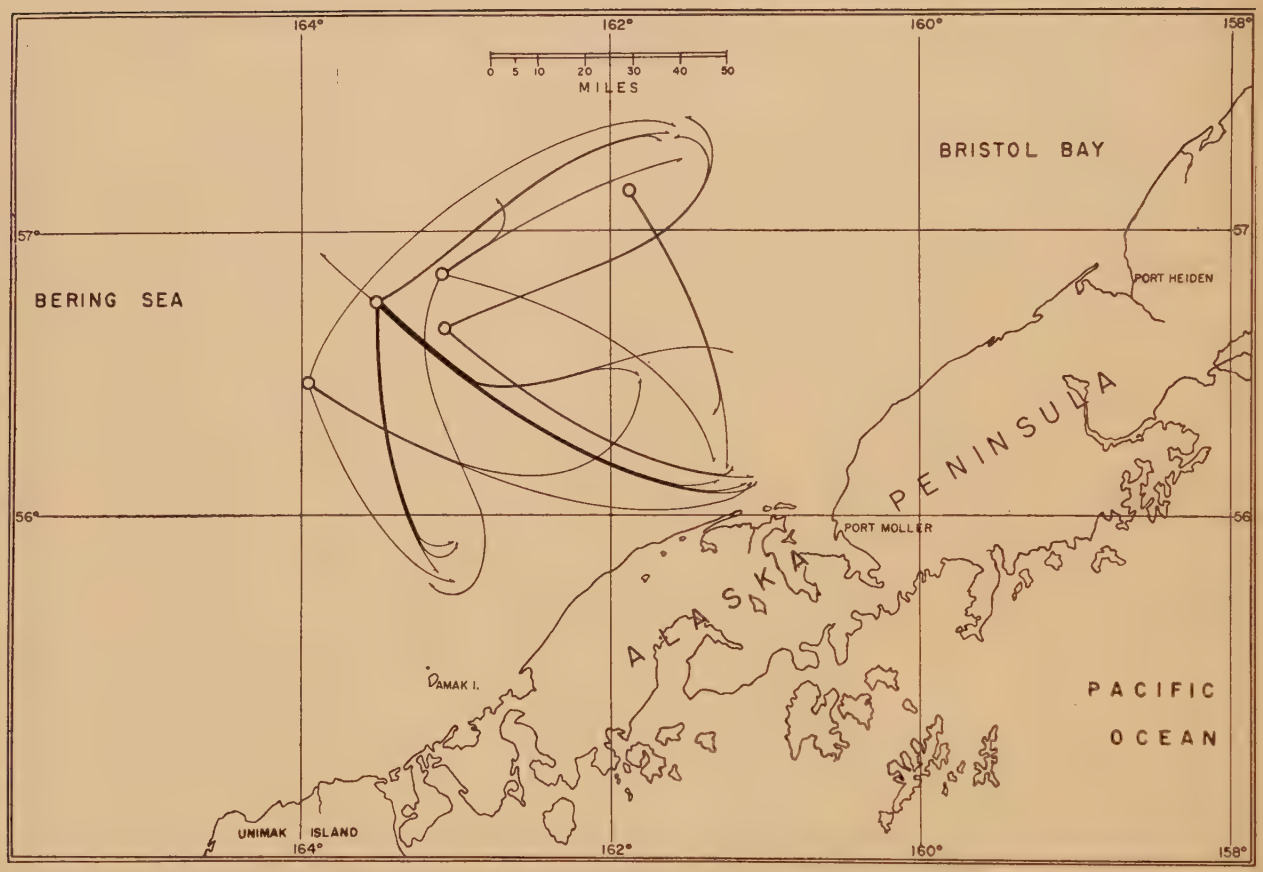

Fig. 13. Migration of tagged king crabs in the Bering Sea; tagged in 1955 and recovered in 1956.